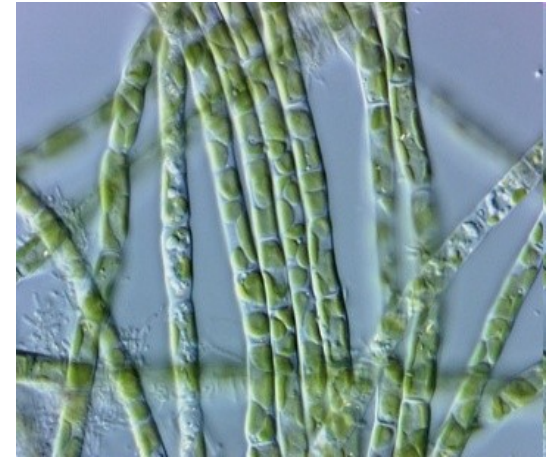
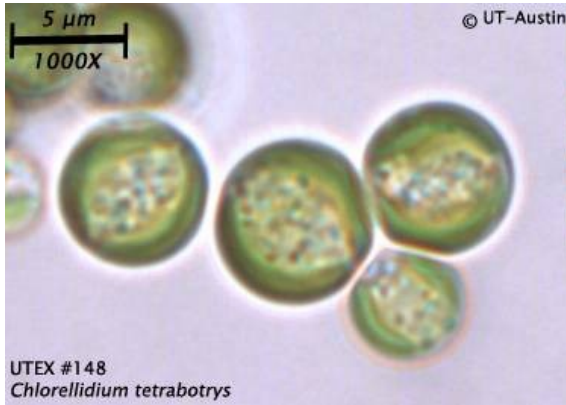


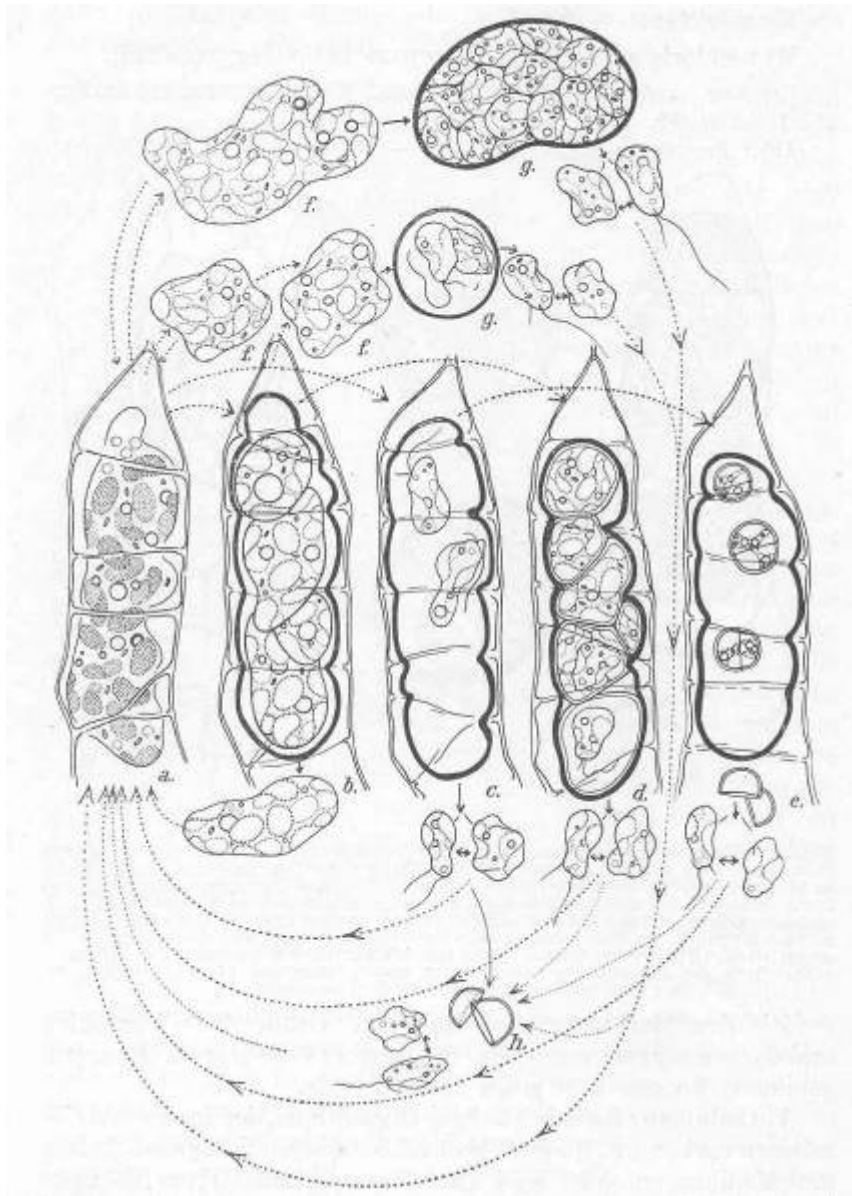
# Xanthophyceae (různobrvky)



- possibly about 900 species, mostly terrestrial and freshwater; most taxa asexual or with cryptic sexual reproduction
- genera *Vaucheria* and *Botrydium* have oogamic or isogamic sexual process



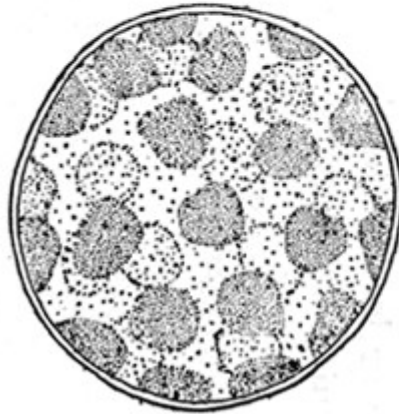
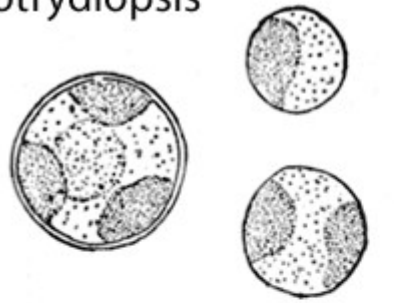
# Myxochloris [sphagnicola]



# Botrydiopsis



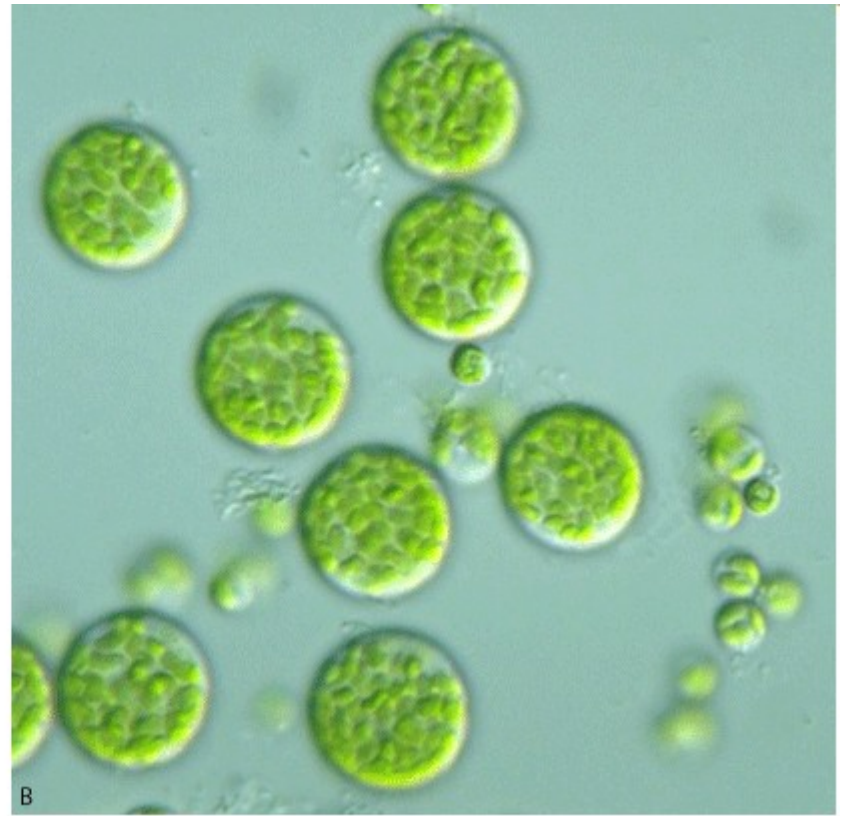
# Botrydiopsis



A

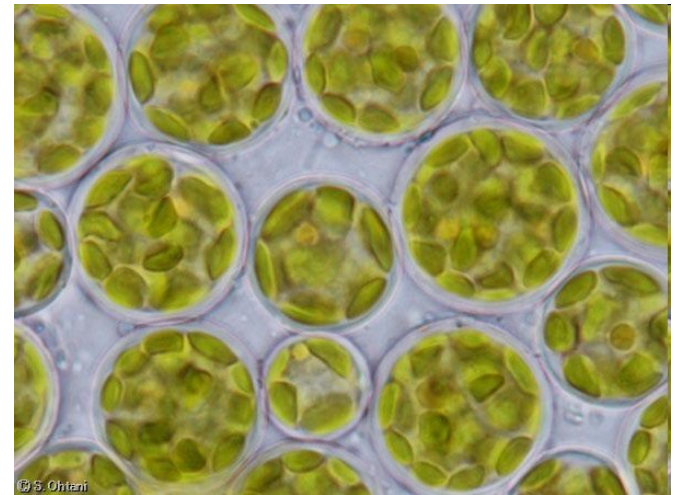
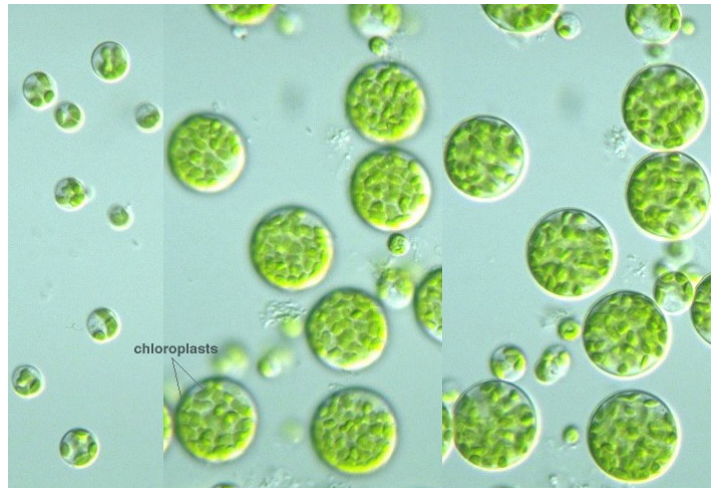
A after Smith (1950)

B © Y. Tsukii, see [http://protist.i.hosei.ac.jp/Protist\\_menuE.html](http://protist.i.hosei.ac.jp/Protist_menuE.html)



B

multiple plastids  
coupled with multiple  
nuclei – so called  
**coenocytes**



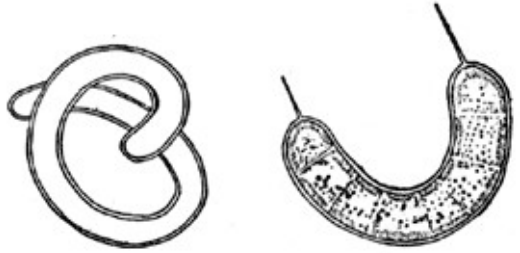
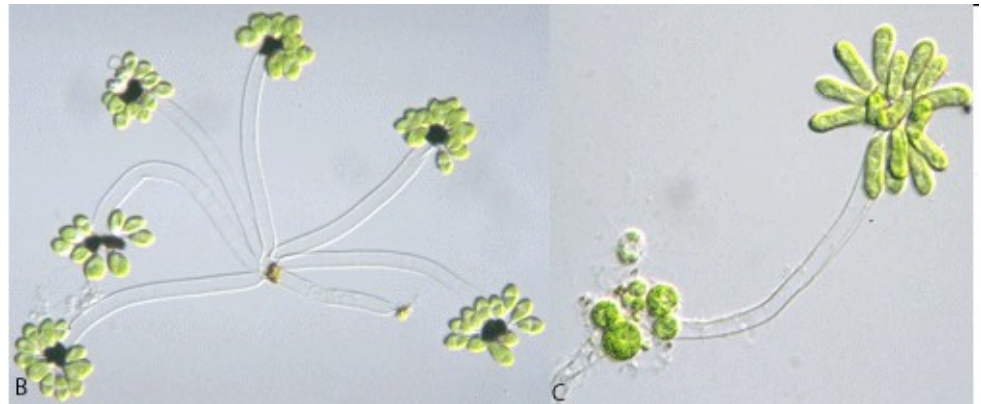
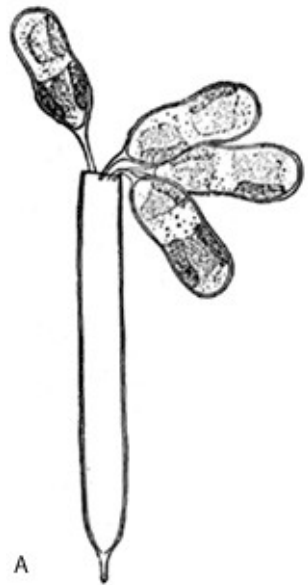
© S. Ohyan

# Ophiocytium

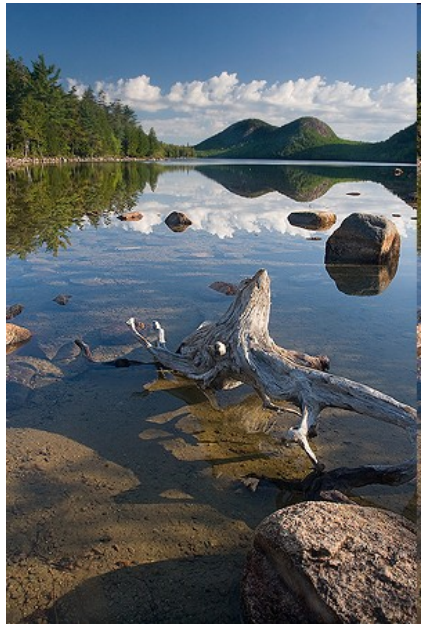
freshwater phytoplankton



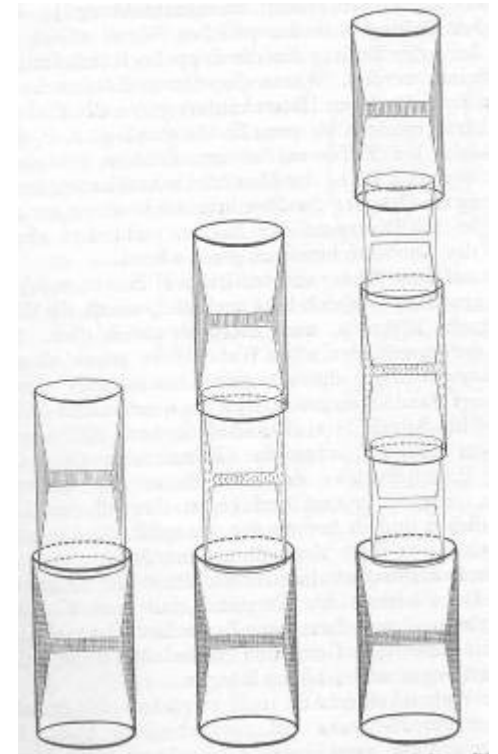
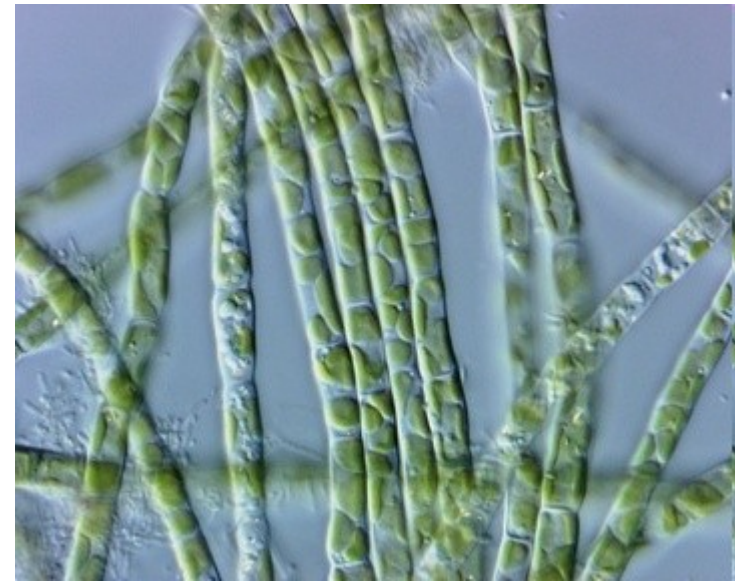
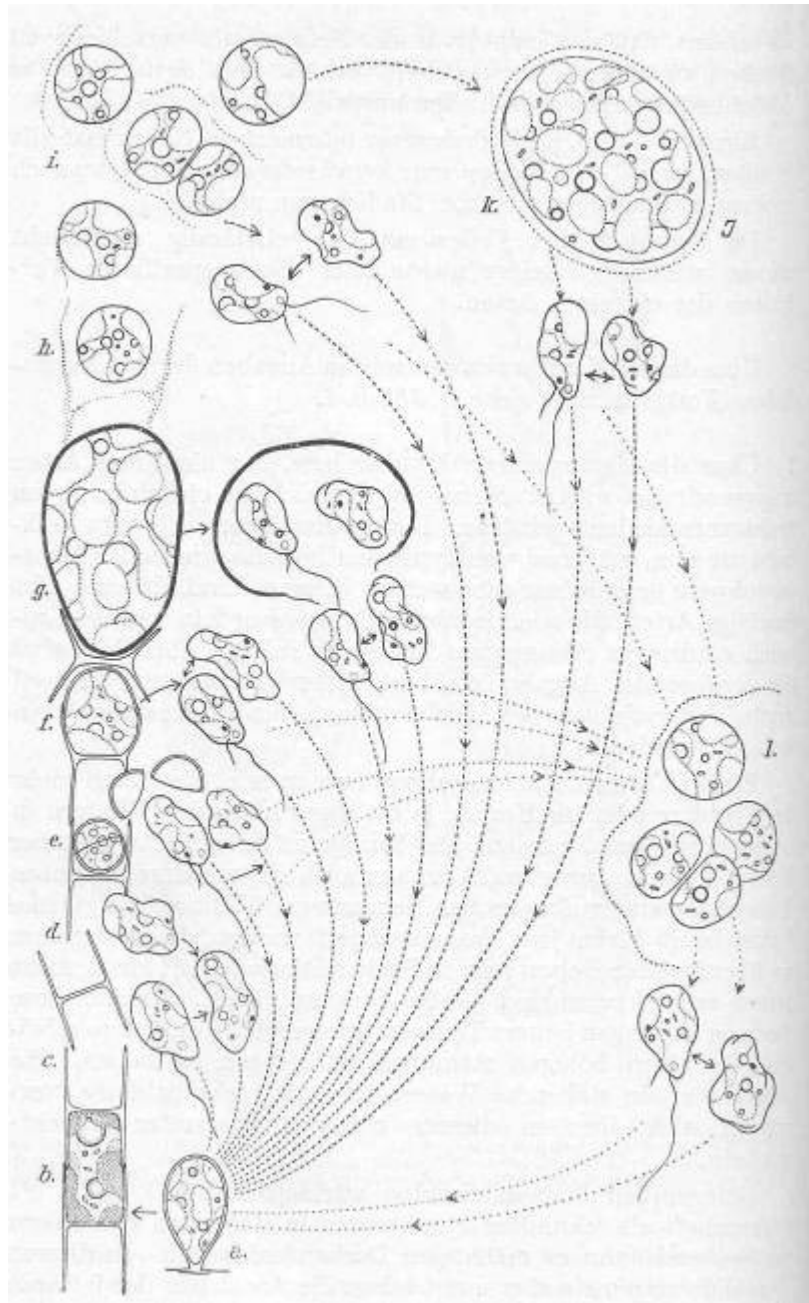
# Ophiocytium



A after Smith (1950)  
B, C, D © Y. Tsukii, see [http://protist.i.hosei.ac.jp/Protist\\_menuE.html](http://protist.i.hosei.ac.jp/Protist_menuE.html)



# Tribonema

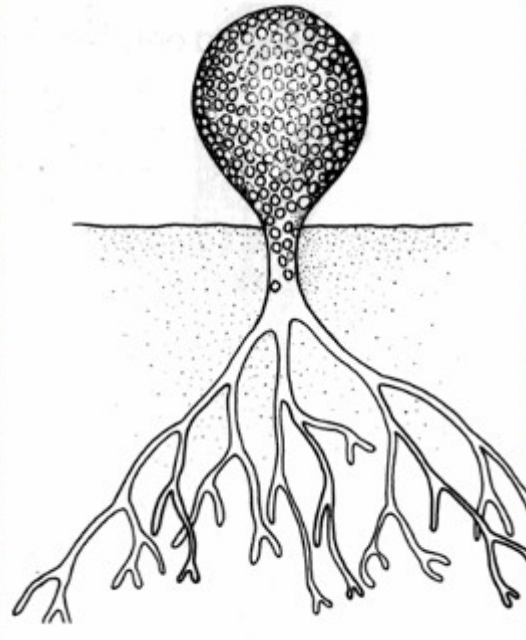


H - kusy

# Botrydium



All after Entwisle et al. (1997)



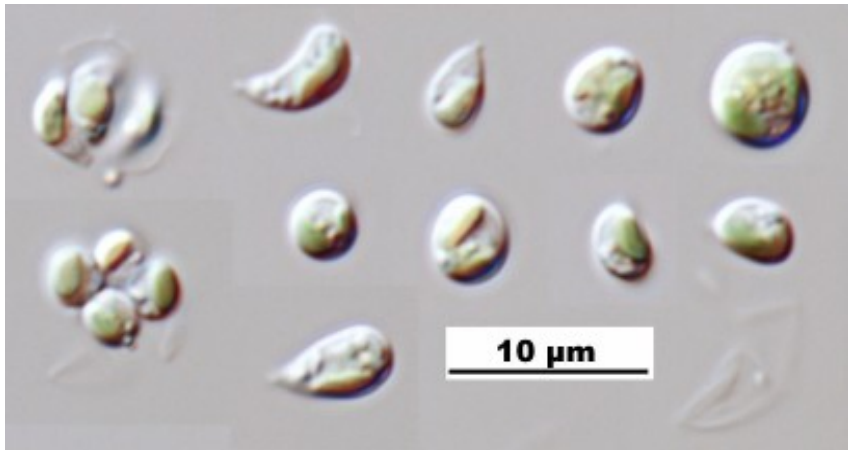
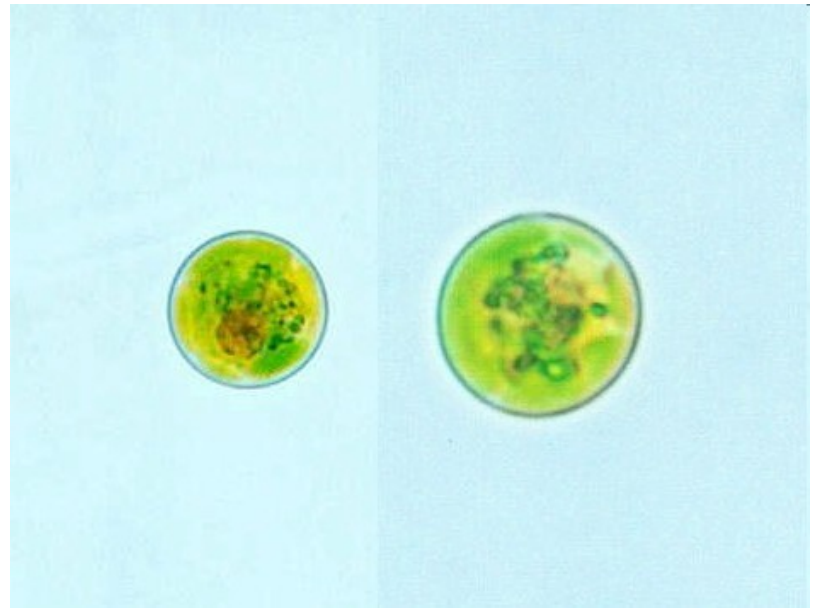
coenocytic thallus



# Vaucheria

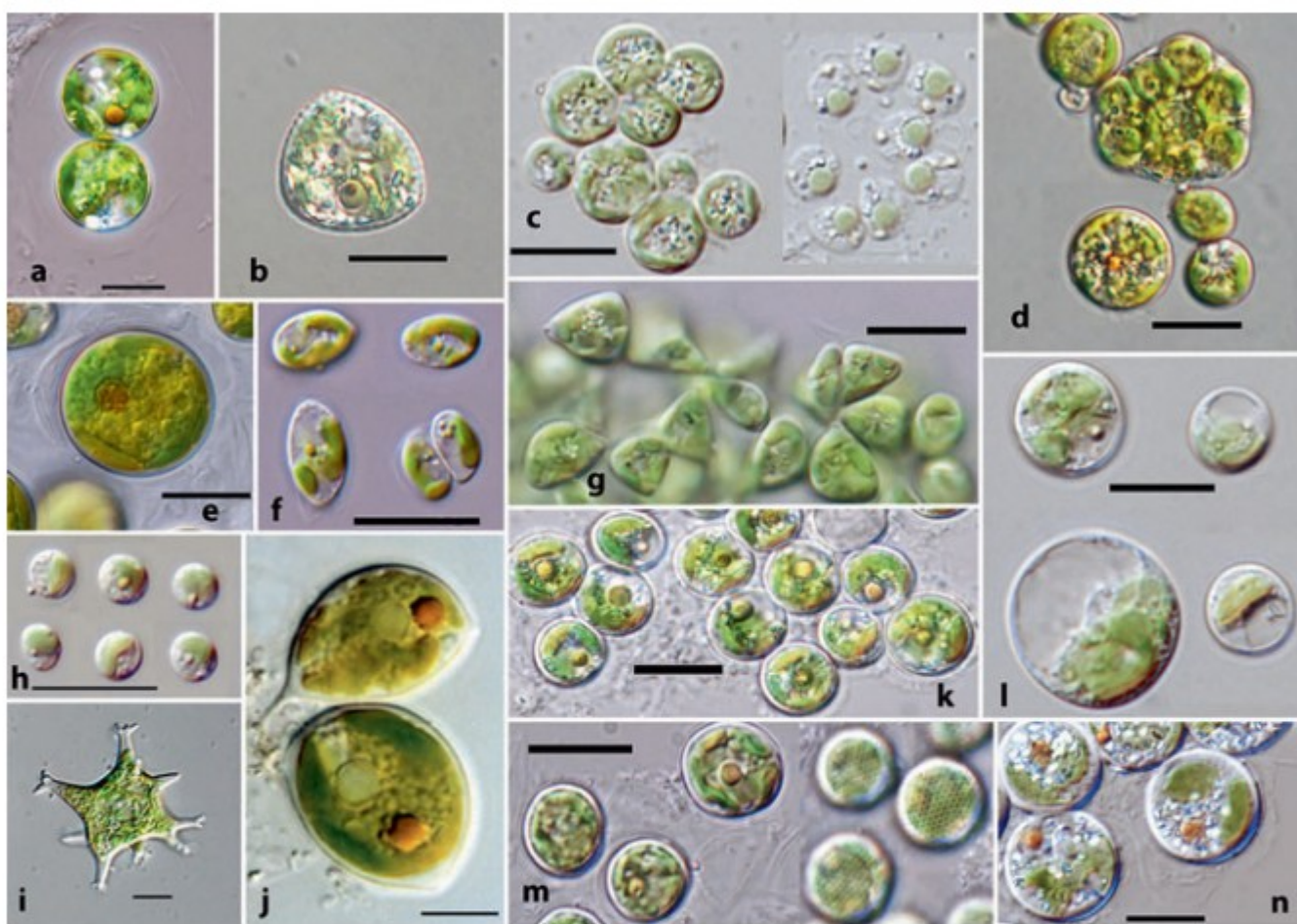


# Eustigmatophyceae

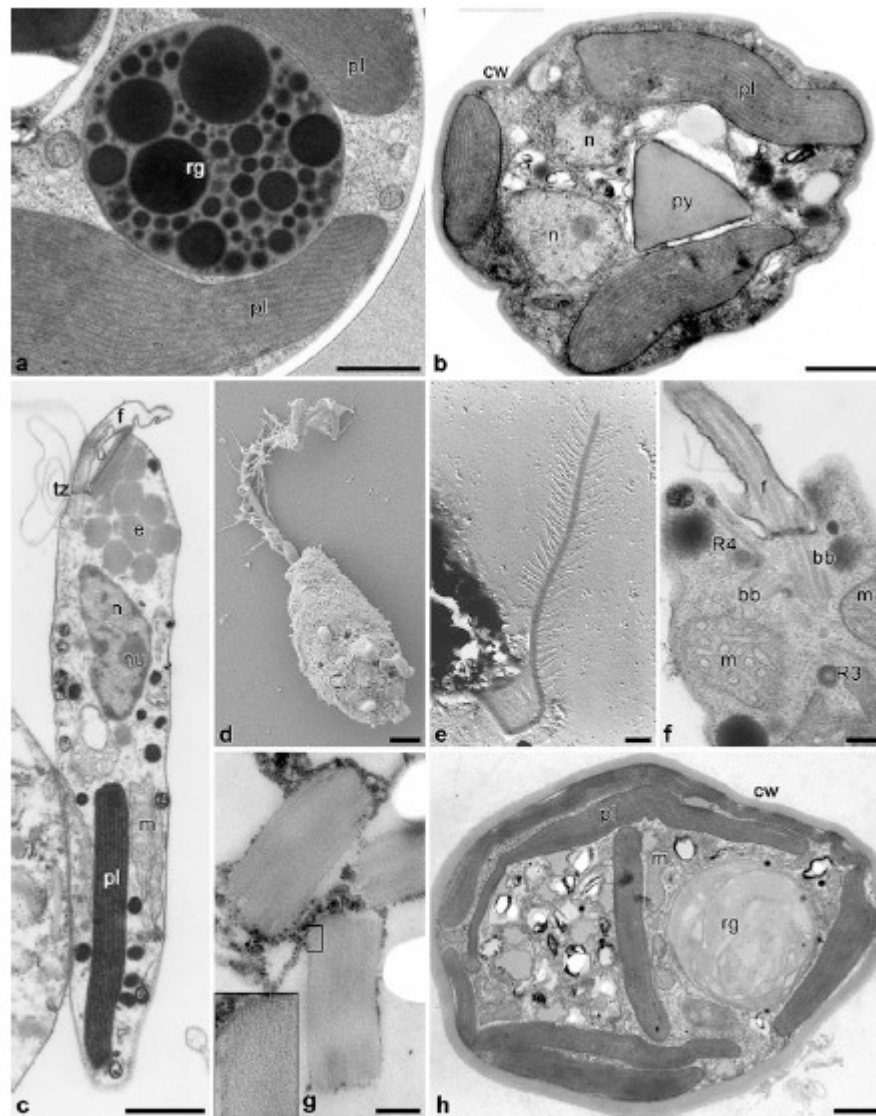


cryptic sexual reproduction  
occurring in soil, freshwater and marine habitats  
most of the diversity probably not yet discovered

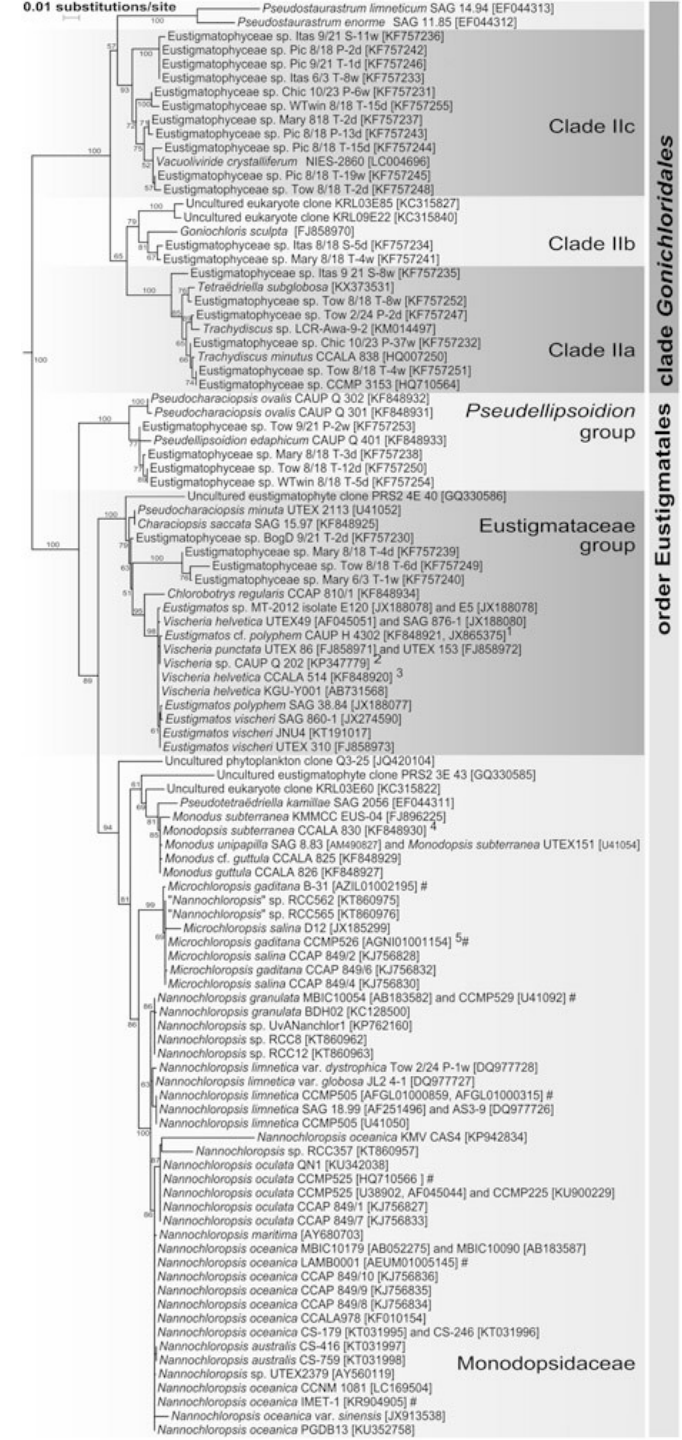




**Fig. 2** Light micrographs of representative Eustigmatophyceae. (a) *Chlorybotrys* sp. UP3 5/31-7m (Eustigmataceae). (b) *Goniochloris sculpta* SAG 29.96 (Clade IIb). (c) Unidentified strain Mary 8/18 T-4d (Clade Ia); vegetative cells (left) and zoospores (right). (d) *Pseudellipsoidion edaphicum* CAUP Q 401 (*Pseudellipsoidion* group). (e) *Eustigmatos polyphem* (Eustigmataceae group). (f) *Monodus unipapilla* Skall 4/27-2w (Monodopsidaceae). (g) Unidentified strain Itas 8/18 S-5d (Clade IIb). (h) *Nannochloropsis limnetica* CCMP 2271 (Monodopsidaceae). (i) *Pseudo-staurastrum* sp. strain 10,174 (*Goniochloridales*). (j) *Characiopsis acuta* ACOI 456 (Eustigmataceae group). (k) Unidentified strain Pic 8/18 T-15d (Clade IIc). (l) Unidentified strain Pic 9/21 T-1d (Clade IIc). (m) Unidentified strain Chic 10/23 P-37 (Clade IIa), illustrating wall sculping (right). (n) Unidentified strain WTwin 8/18 T-15d (Clade IIc). Bars = 10  $\mu$ m



**Fig. 3** Cell ultrastructure in the Eustigmatophyceae. (a) Detail of a plastid (without the girdle lamella) and a reddish globule of *Vischeria helvetica* (pl plastid, rg reddish globule). (b) Section of a vegetative cell of *Eustigmatos magna*, presumably on a way to cytokinesis (note the two nuclei; cw cell wall, n nucleus, p pyrenoid, pl plastid). (c) Zoospore of *Vischeria helvetica* (e eyespot, f flagellum, m mitochondrion, n nucleus, nu nucleolus, pl plastid, tz transitional zone of the flagellum). (d) Zoospore of *Trachydiscus minutus* in a scanning electron microscope. (e) Detail of the flagellum bearing mastigonemes, *Vischeria stellata*. (f) Longitudinal section of the flagellar apparatus of *Vischeria stellata* unflagellate zoospore showing basal bodies with R3 and R4 flagellar



examples of (eustigmatophyte) mass cultures and photobioreactors - primarily *Nannochloropsis*



*Nature Beta Technologies Ltd, Eilat, Israel*

source of arachidonic acid (ARA) and eicosapentaenoic acid (EPA)



Nannochloropsis farms for animal food production (fish aquacultures, etc.)



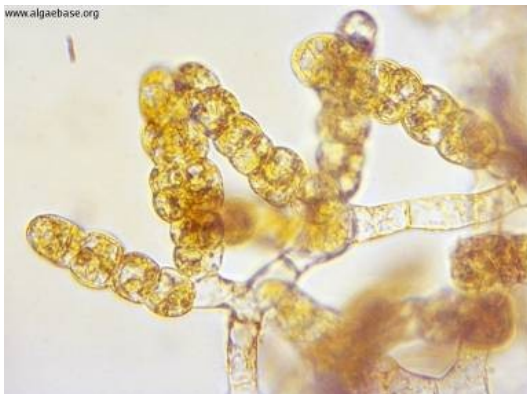
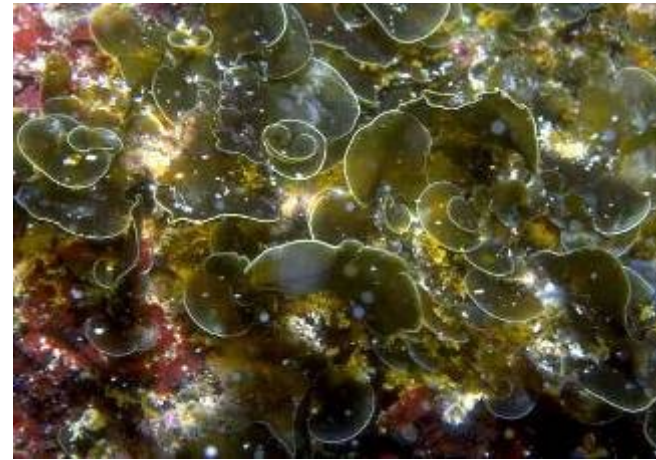
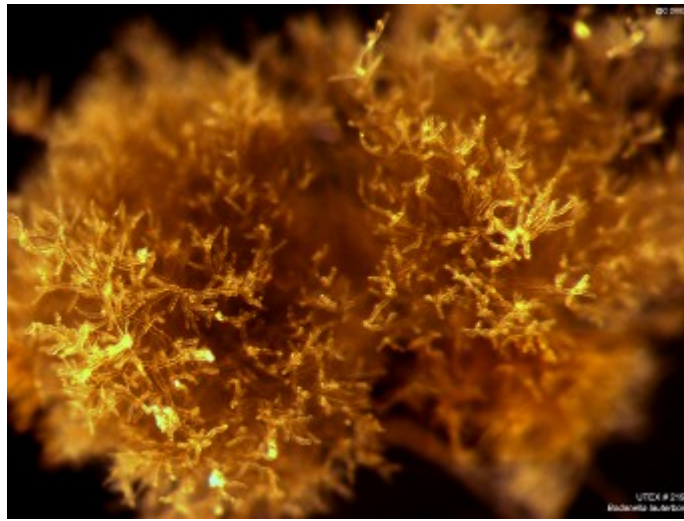
additional links:

<https://meticulousblog.org/top-companies-in-nannochloropsis-market/>

<https://finance.yahoo.com/news/global-nannochloropsis-market-2021-2028-150600787.html>

Greenwell et al, 2010, J Royal Soc

# Phaeophyceae - chaluhy

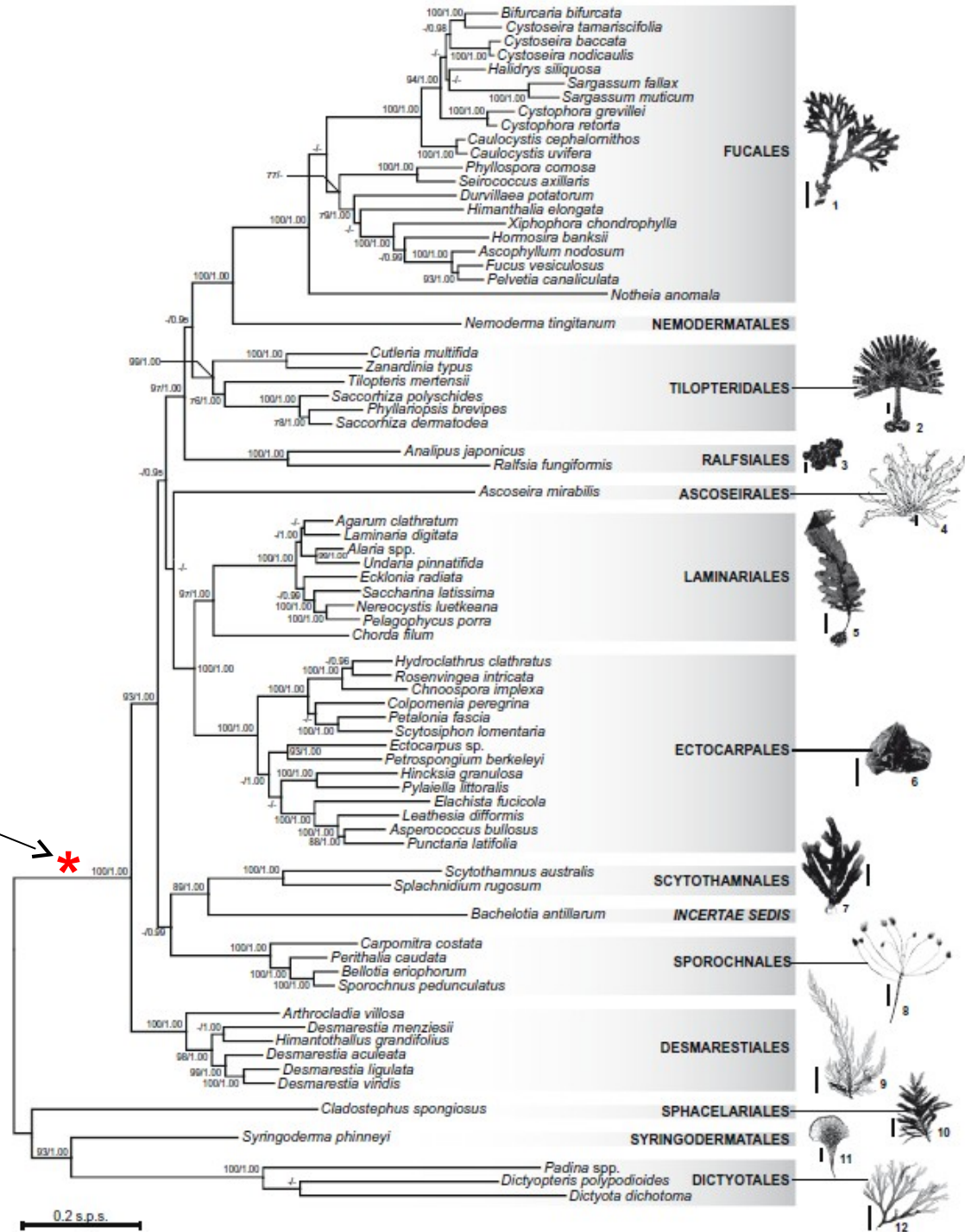


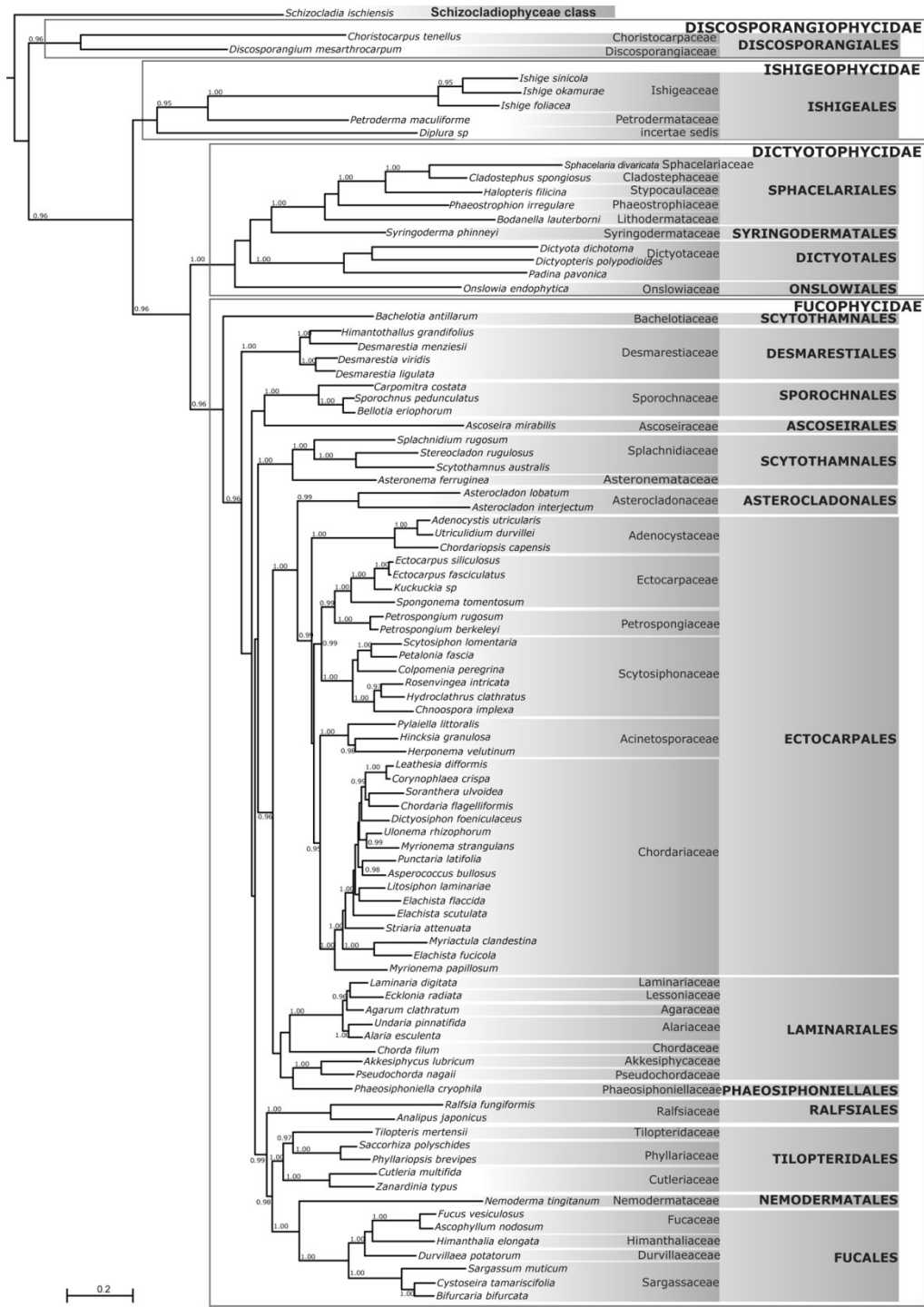
- about 2000 species are known,
- only 3 genera freshwater
- all the others live in marine eulittoral and sublittoral
- heterotrichal to complex macroscopic thalli,
- fucoxanthin – brown carotenoid pigment;
- obscure polysaccharides in cell walls – production of alginates;
- maricultures, source of iodine in food webs

# Phylogeny of Phaeophyceae

(ML tree, 10 genes)

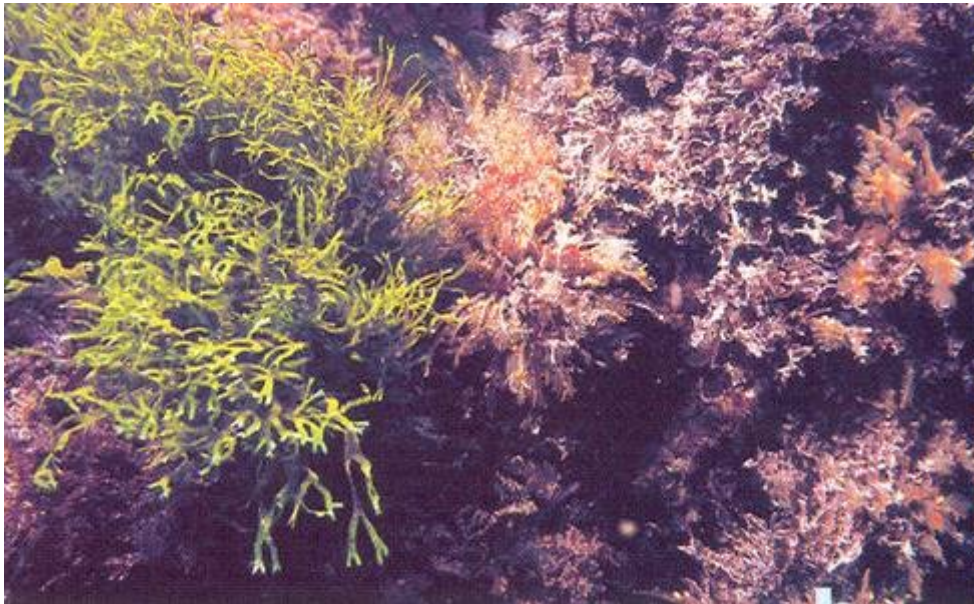
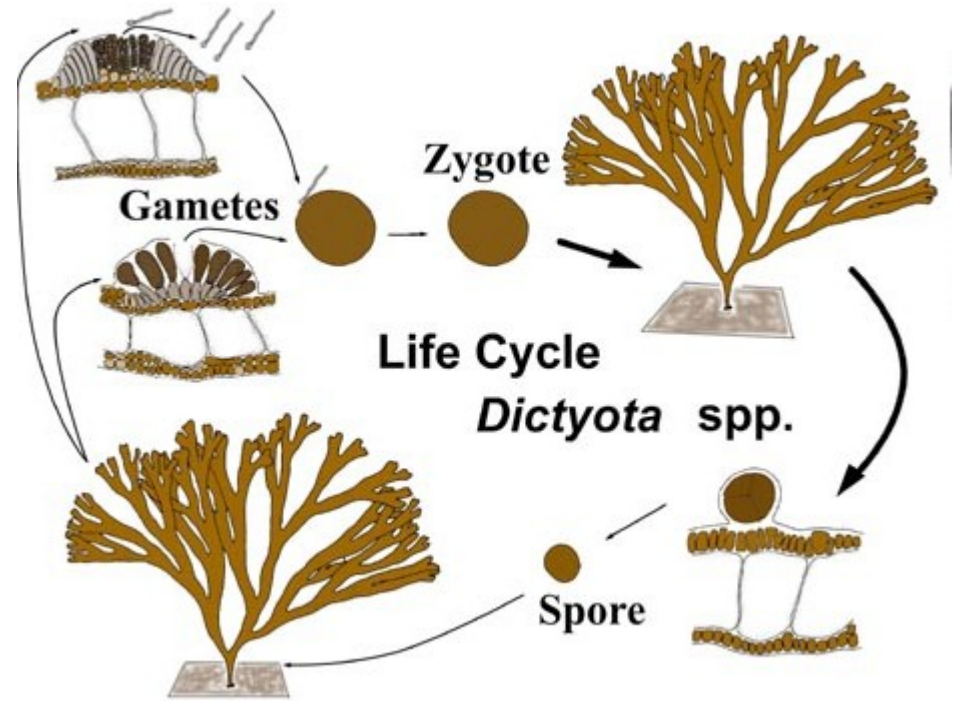
heteromorphic life cycle





Silberfeld et al., 2014,  
Crypt. Algal. 35: 117-156.

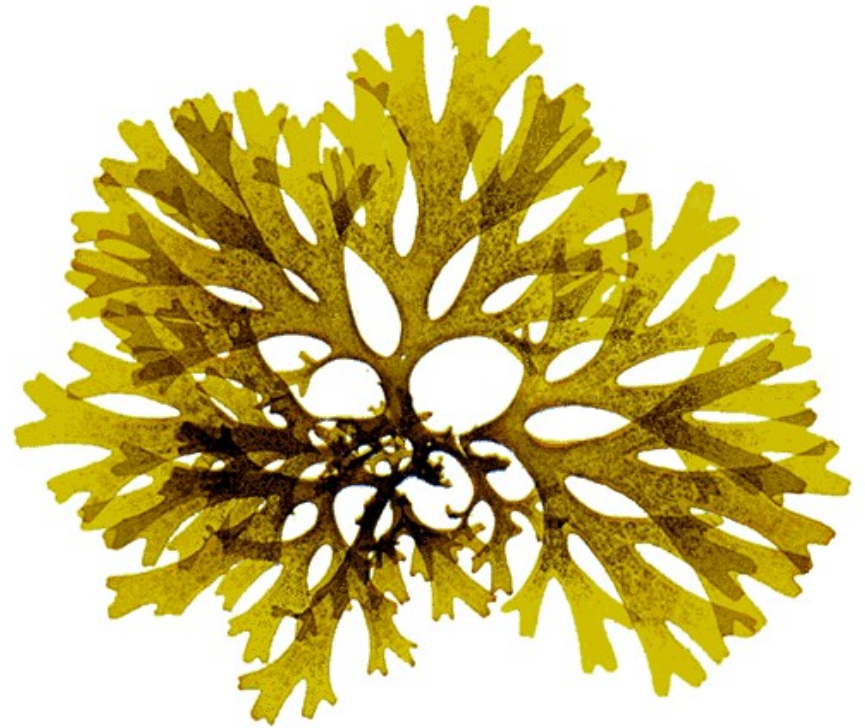
# Dictyota



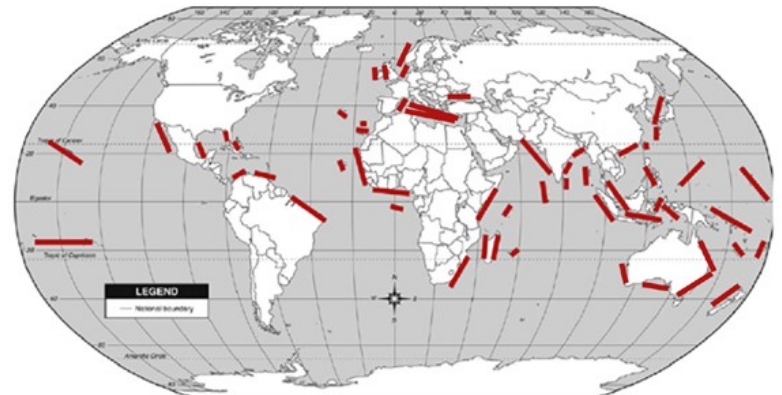
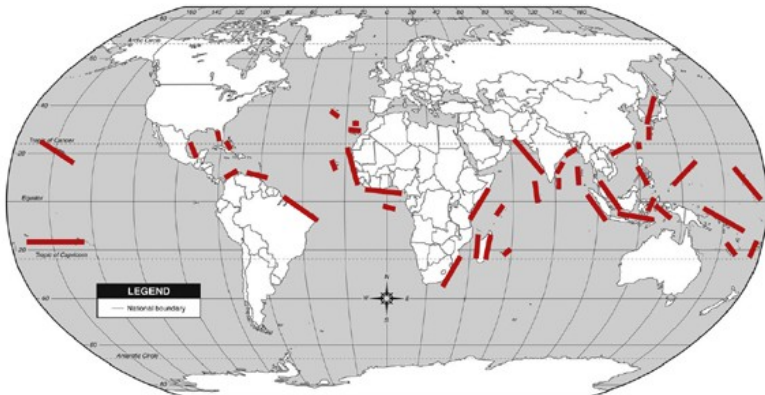


*Dictyota bartayresiana*

Dictyota bartayresiana



Dictyota dichotoma



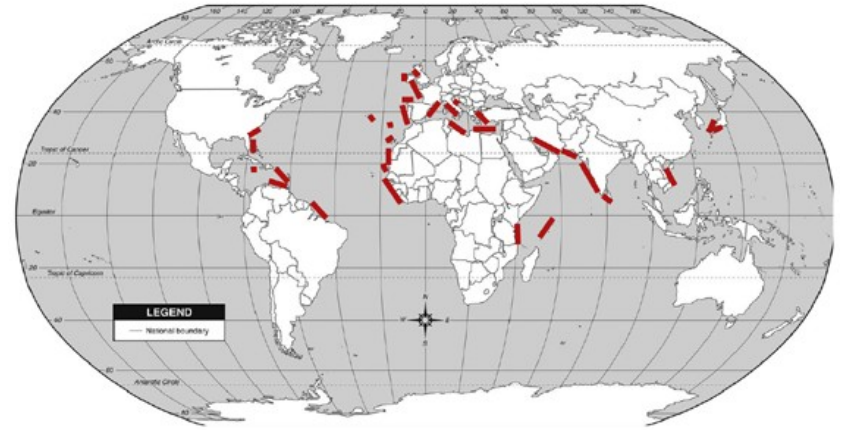




# Dictyopteris



shade-loving species, sheltered habitats



*Dictyopteris polyodioides*

# Padina

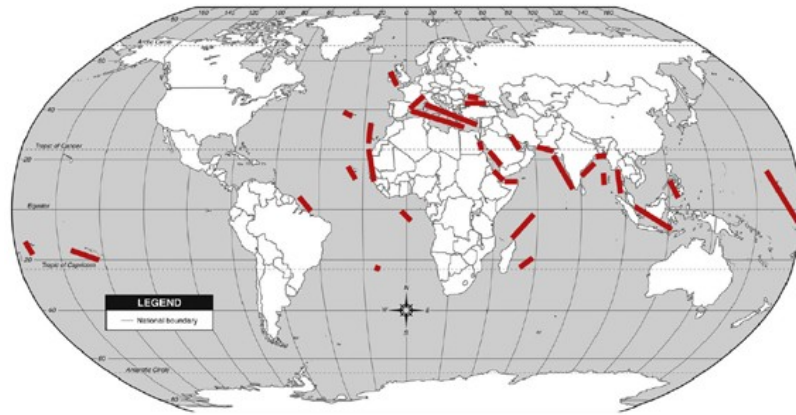


cosmopolitan sublittoral genus;  
often in ruderal localities of disturbed  
tropical ecosystems ;  
calcified thalli

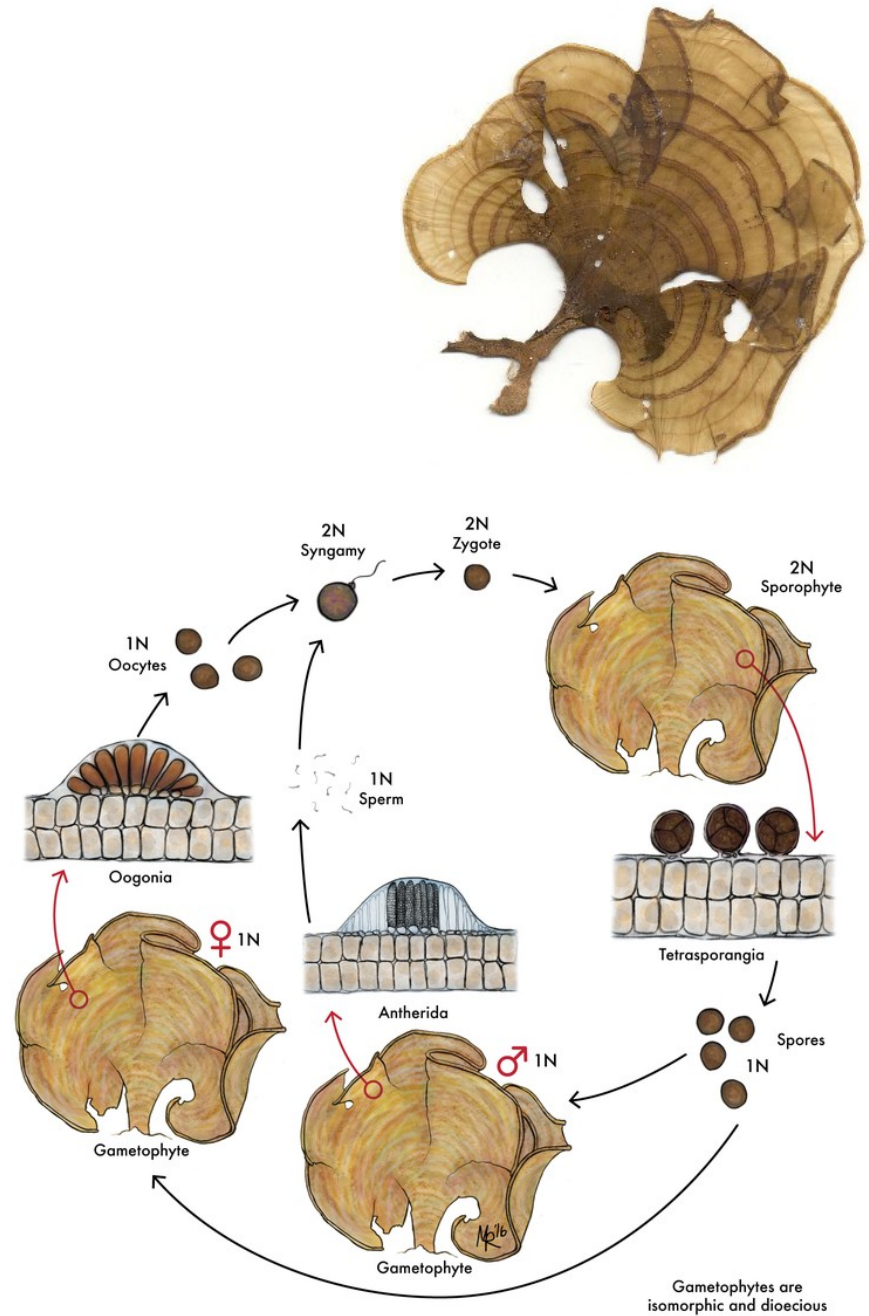




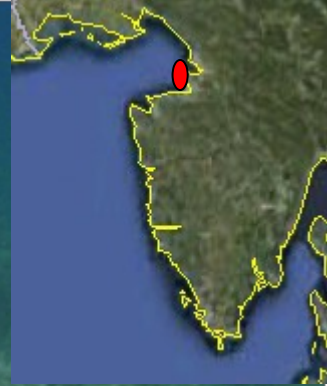
*Padina pavonica*



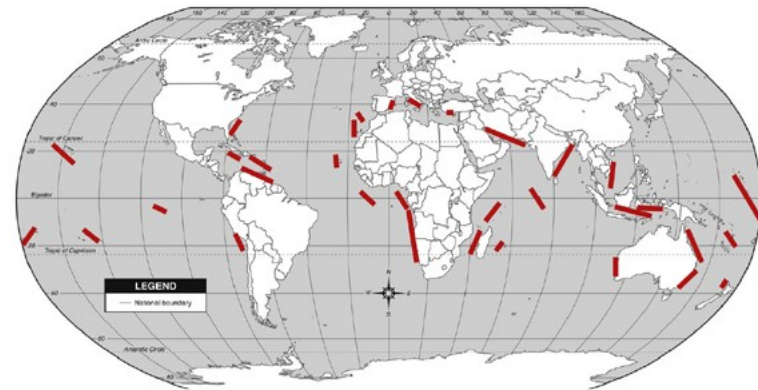
frequent Mediterranean species,  
upper sublittoral



Gametophytes are isomorphic and dioecious



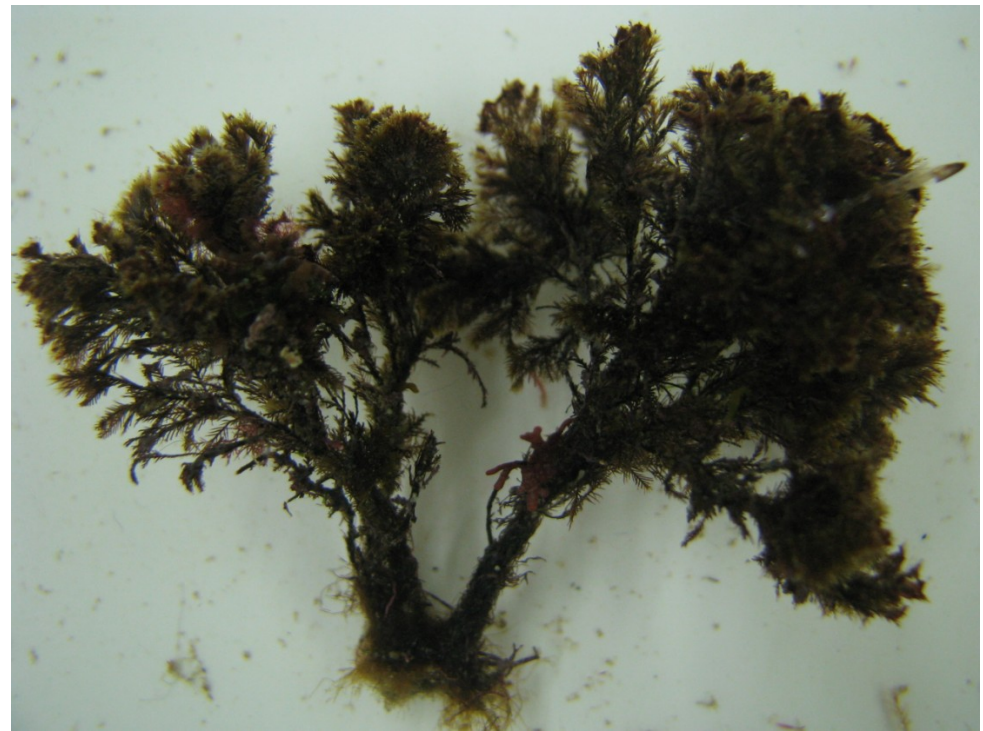
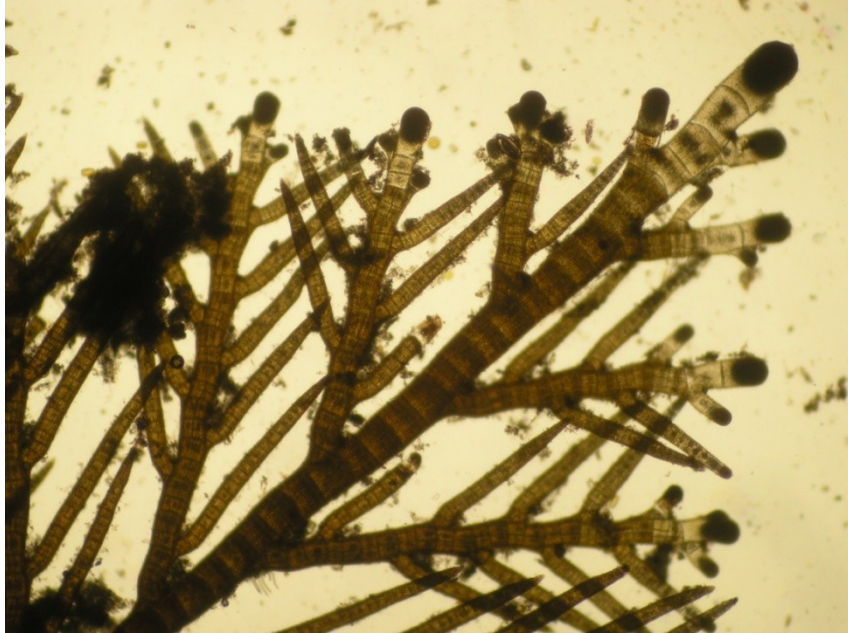
# Lobophora



*Lobophora variegata*

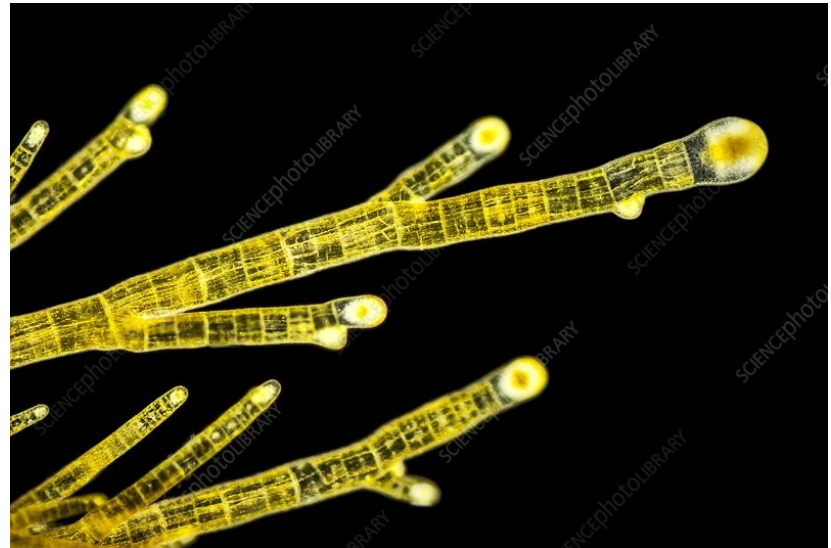
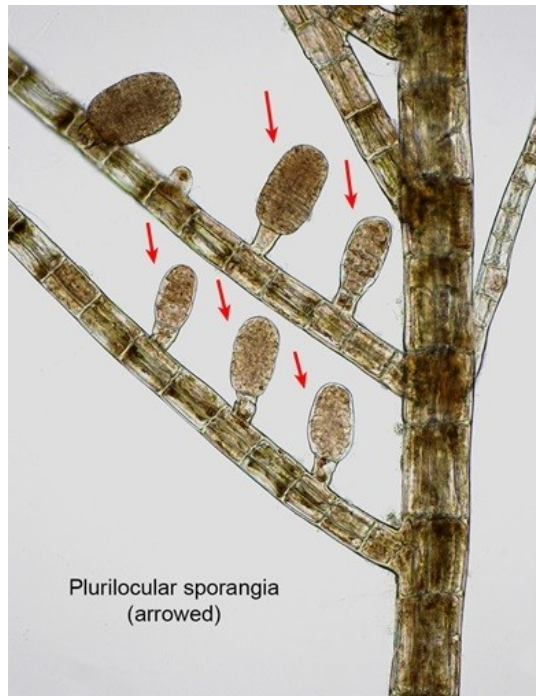
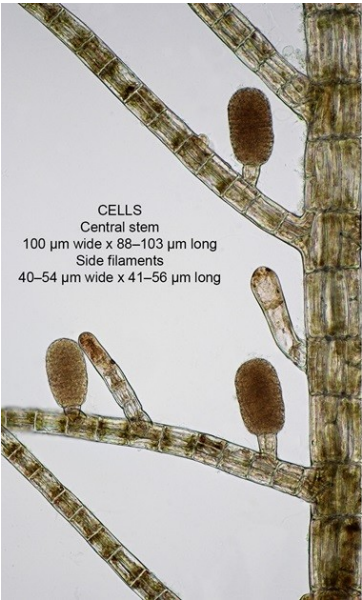
# *Sphacelariales*

*Halopteris*, *Stypocaulon*, *Sphacelaria*  
some of the most frequent phaeophyceans in  
the Mediterranean and European Atlantic coast



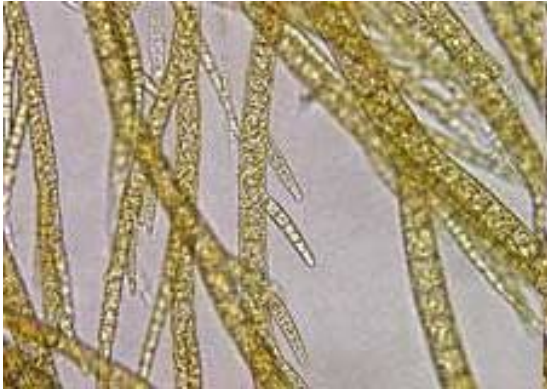


# Sphacelaria

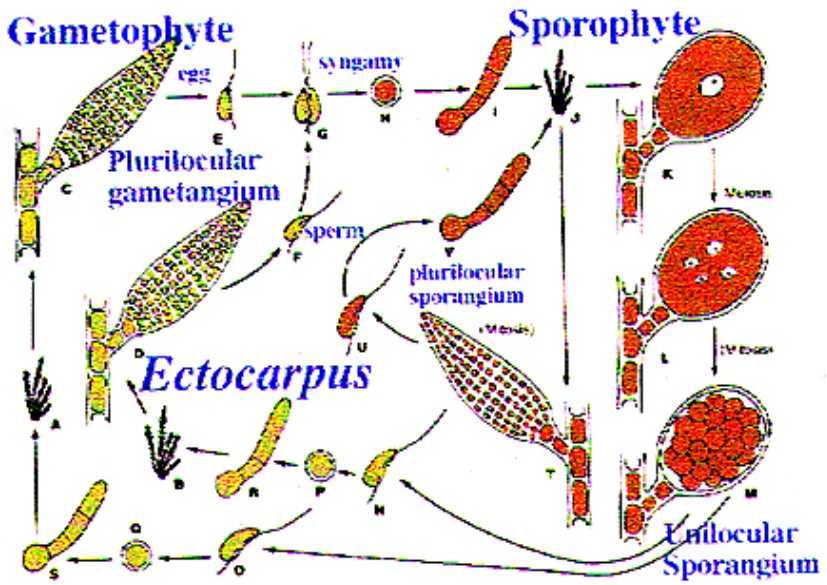


# Ectocarpales

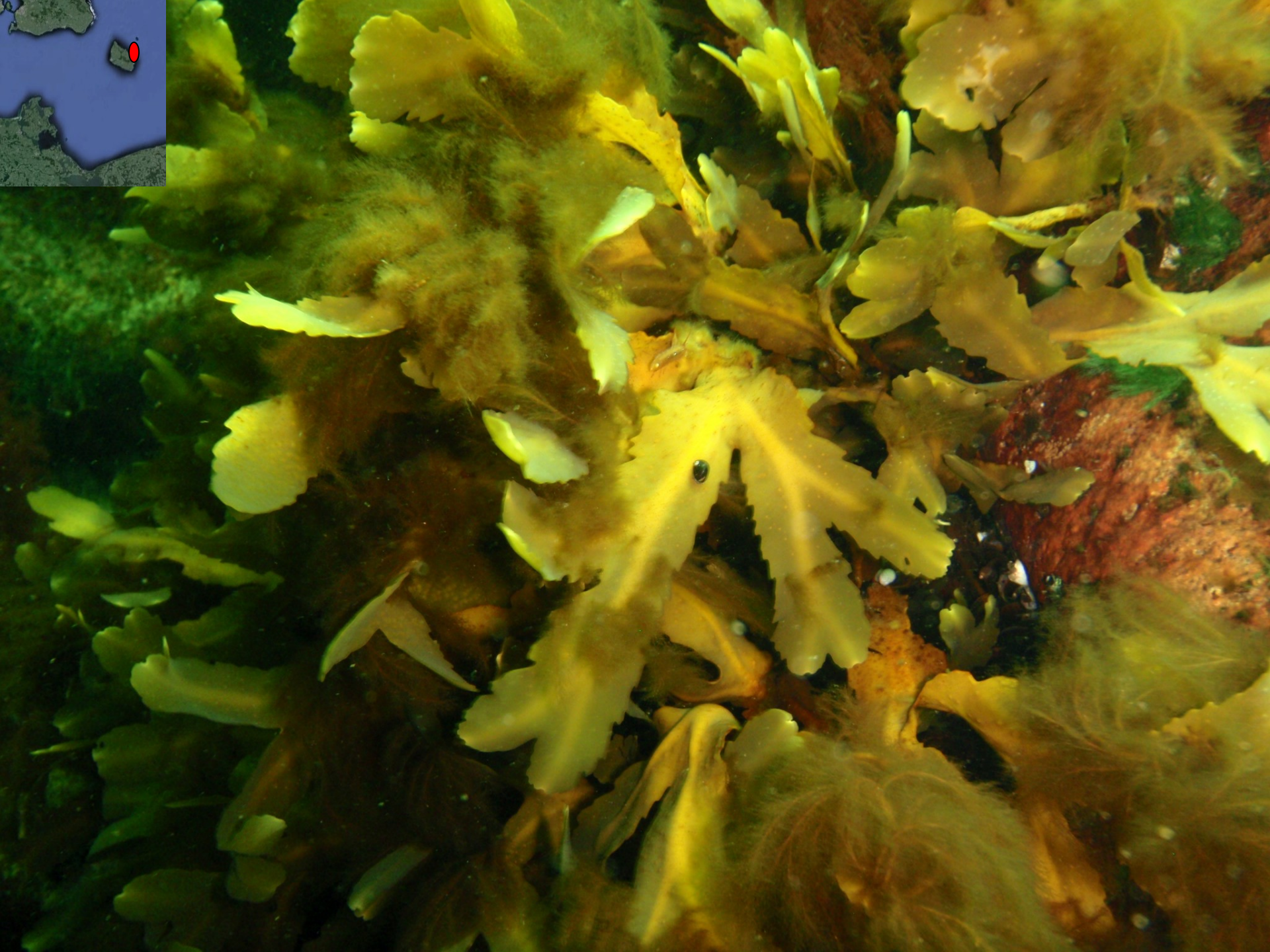
## Ectocarpus



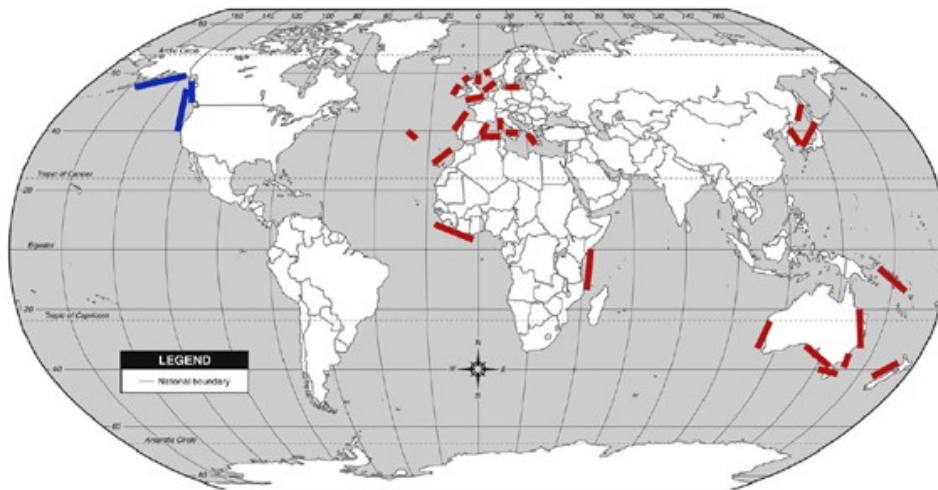
Ectocarpus w/ plurilocular structure  
Univ Catania



heterotrichal thallus, (almost) isomorphic life cycle, marine and brackish sublittoral



# Colpomenia

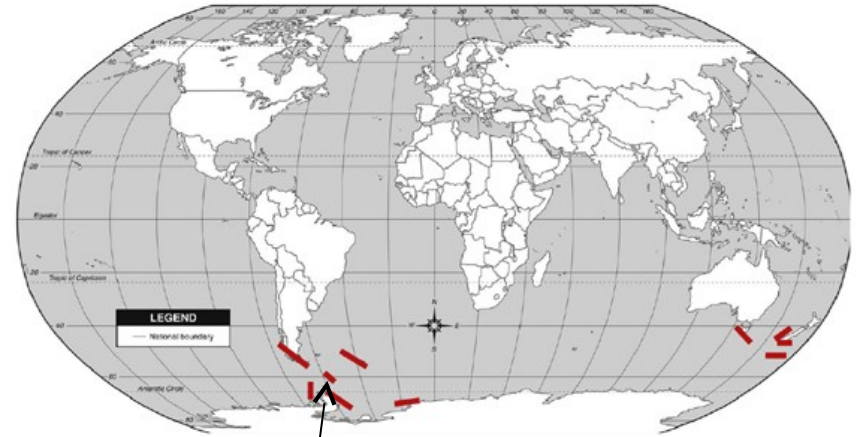


*Colpomenia peregrina*

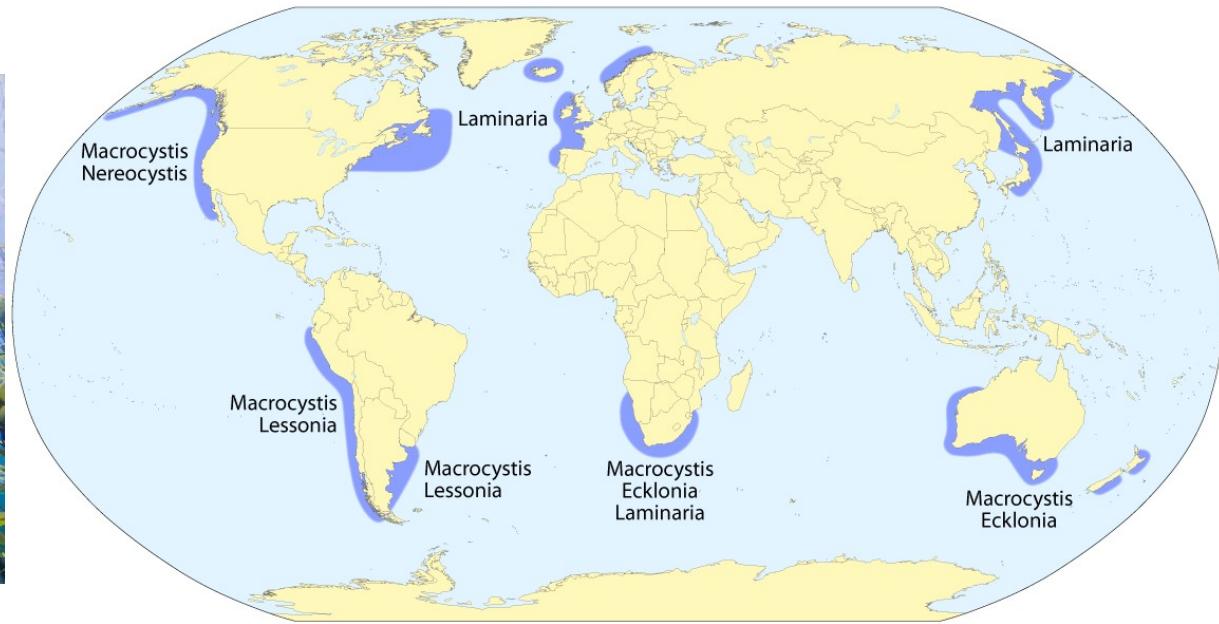


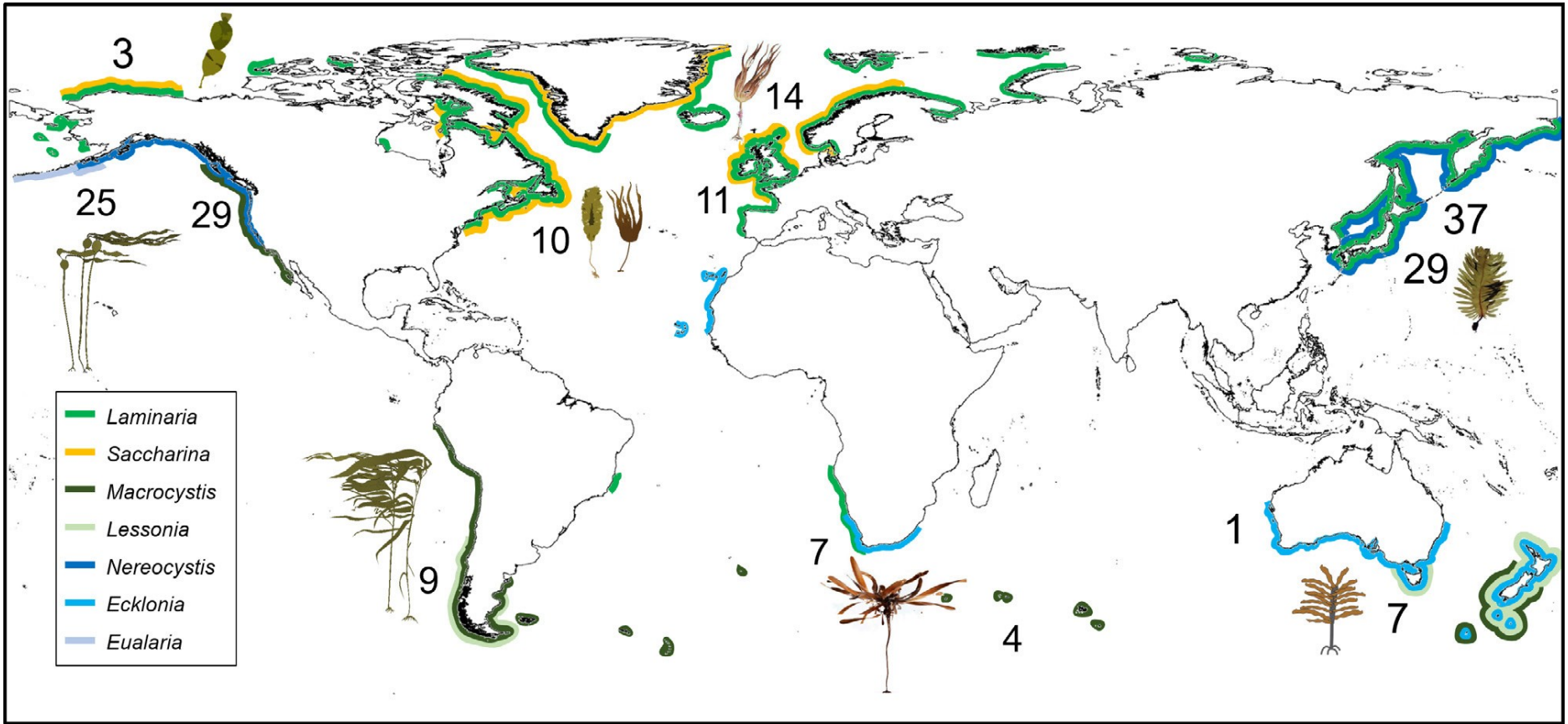
invasive lineage in subtropical seas, origin in N Pacific

# Adenocystis



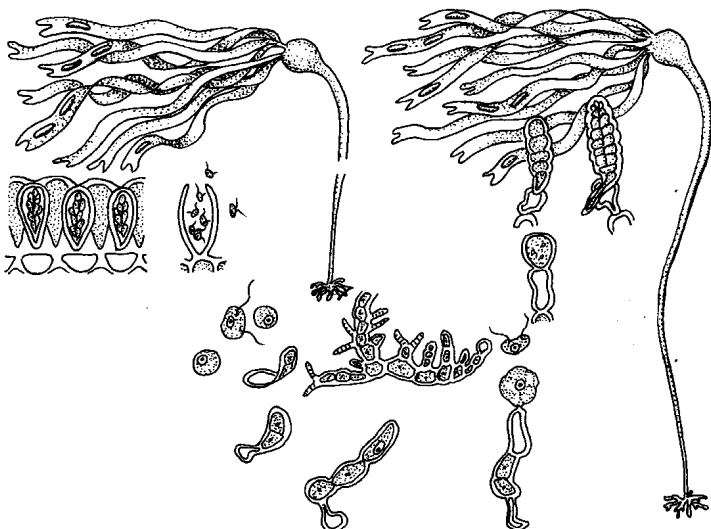
# Kelp ecosystems





# Laminariales

## Laminaria



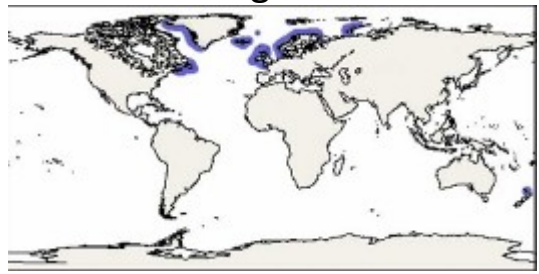
Jay/97

Ivy Livingston © BIODIDAC

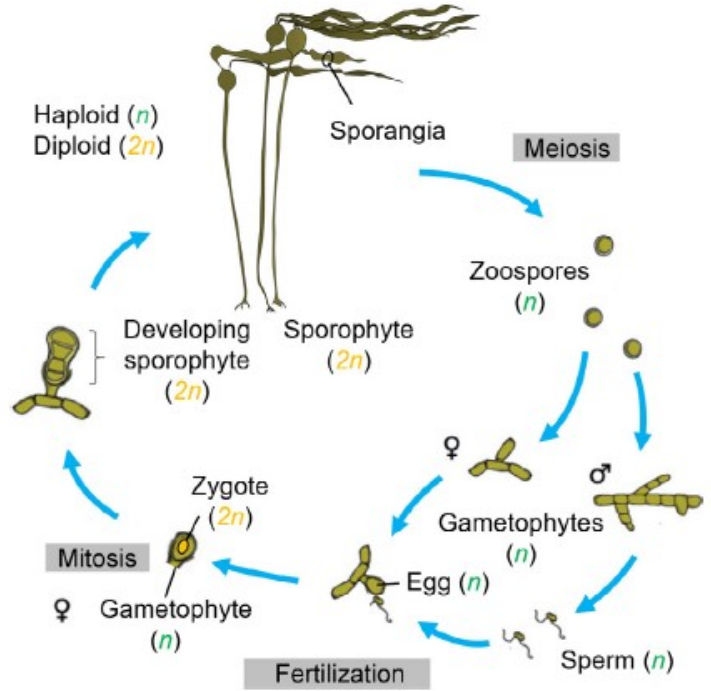
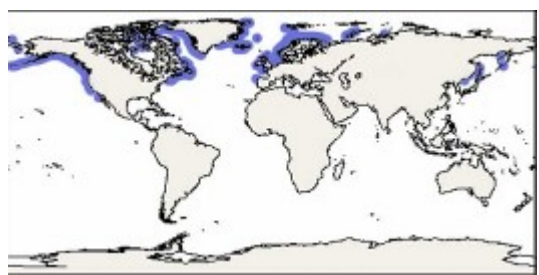


Photo by: Hans Christian Andersen

L. digitata

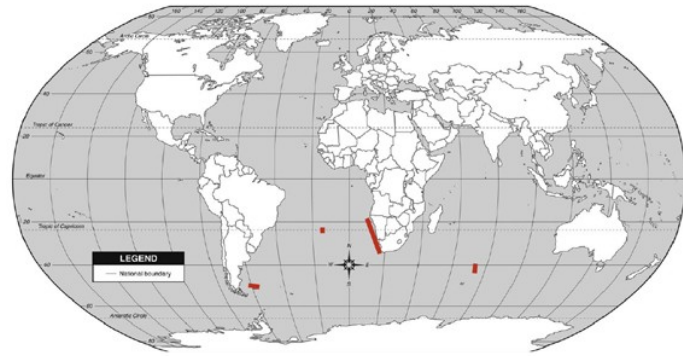


L. saccharina





# Ecklonia

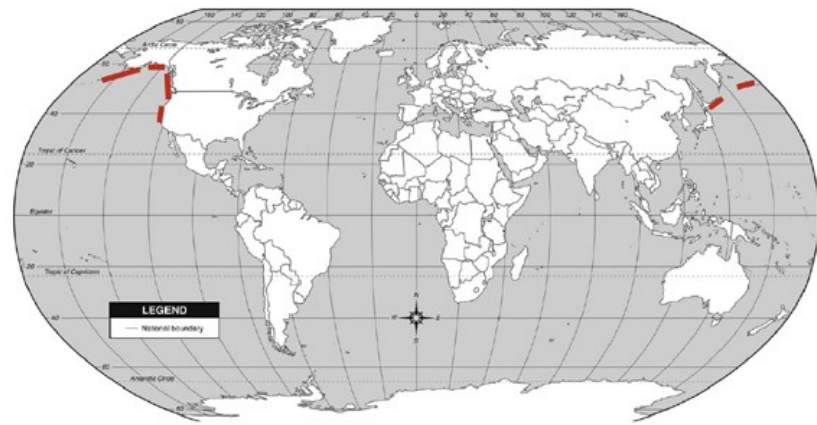


*E. maxima*

key genus of kelp forests on S Hemisphere



# Alaria



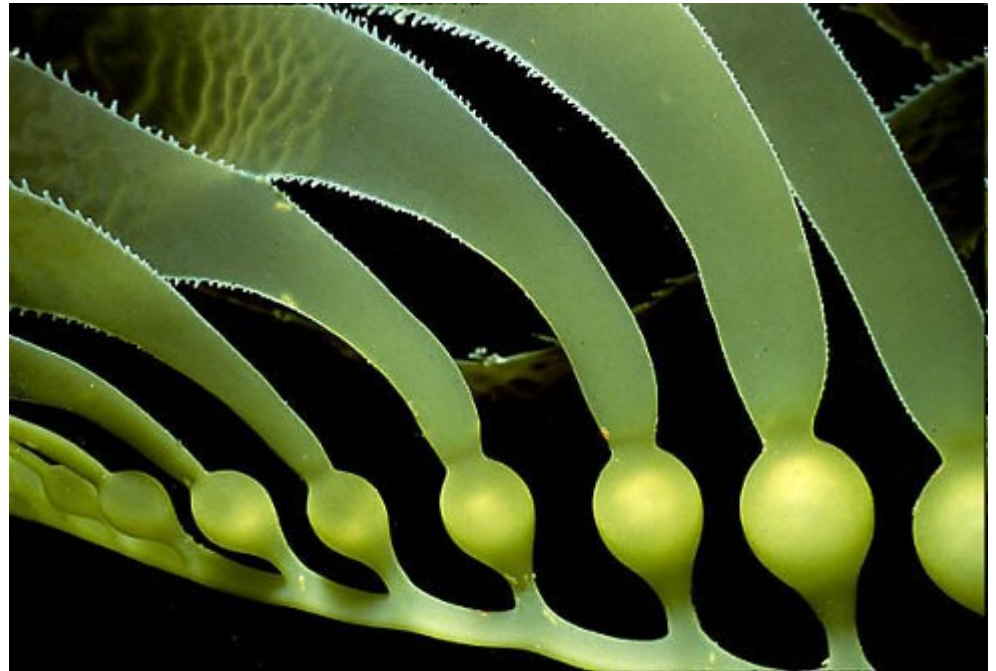
*A. marginata*

mostly Pacific genus (Alaska, Aleutian Islands, E Siberia)

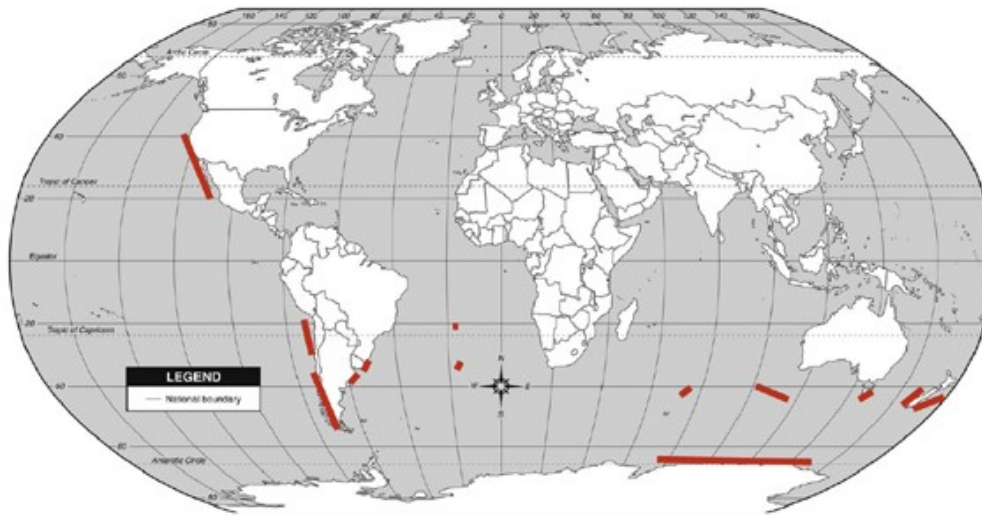


intertidal a subtidal kelp communities (N/W Pacific)

# Macrocystis

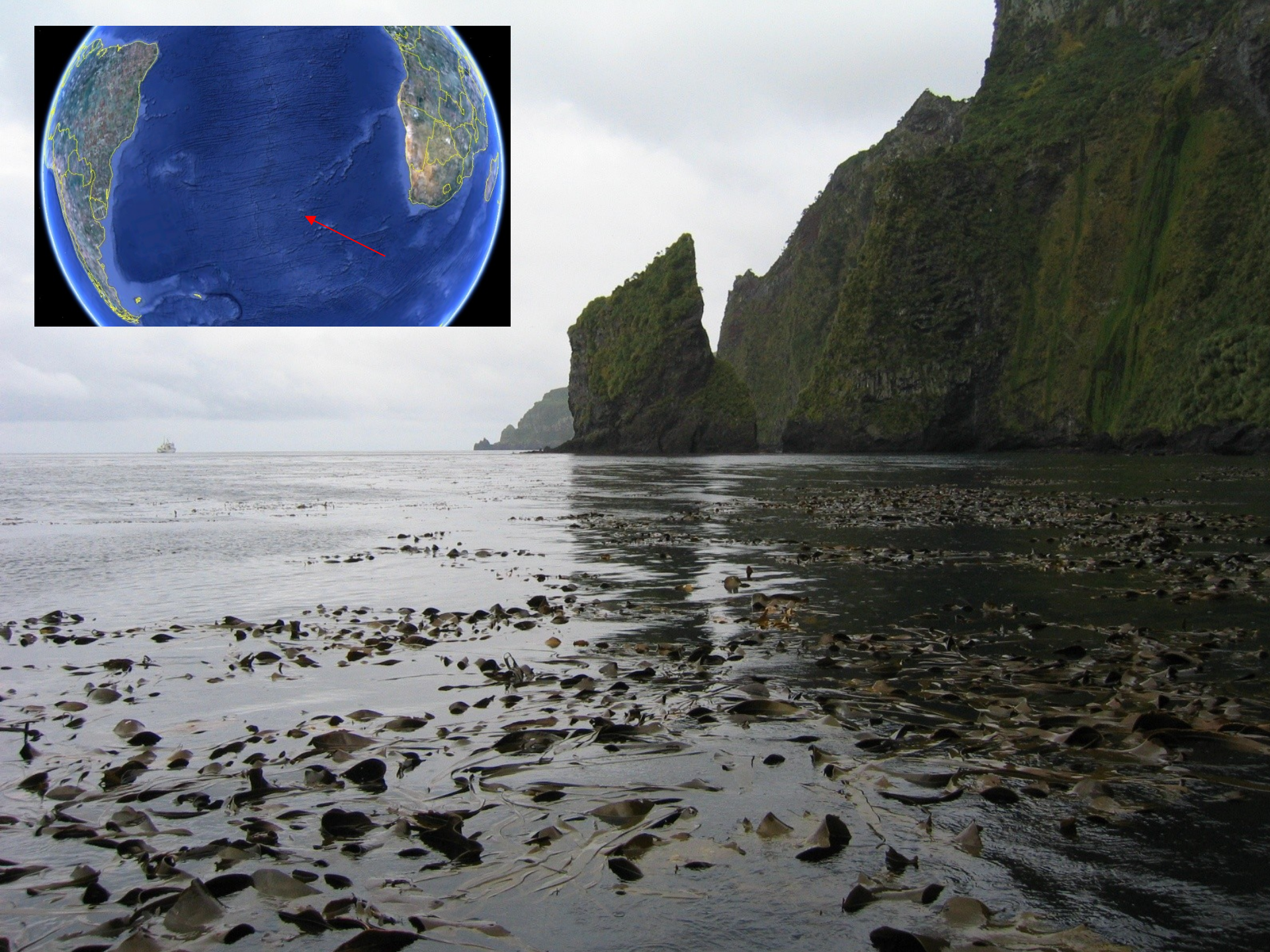
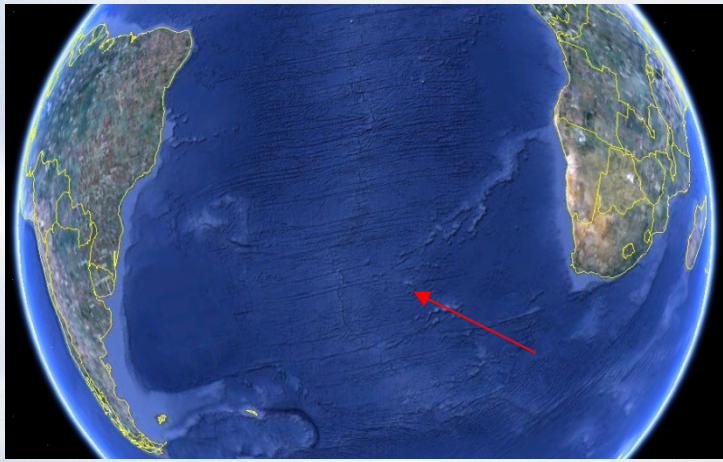


dominant circum-antarctic genus (+ Pacific coast of America)

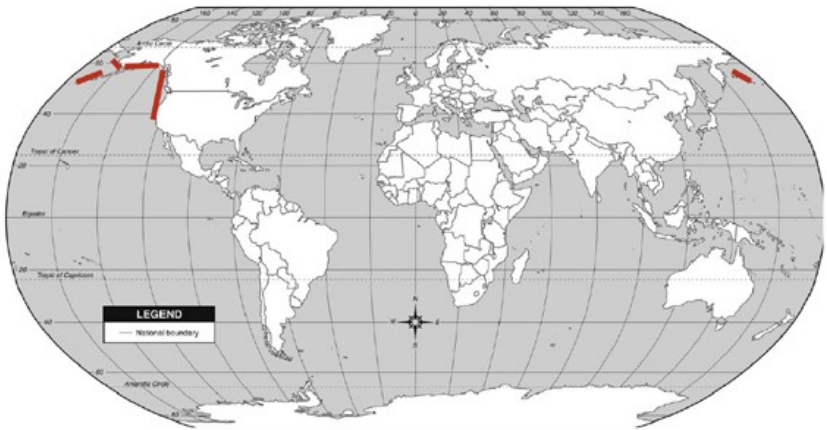
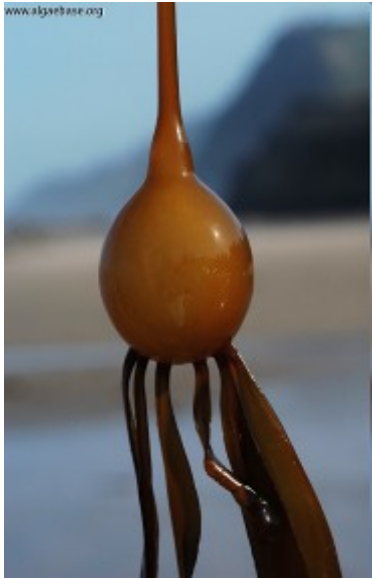


*M. pyrifera*






# Nereocystis (luetkeana)





**Postelsia palmaeformis**  
(*diminutive palm kelp*)



 algaeBASE

Pacific coast of North America  
intertidal (i.e. frequently exposed to dessication)

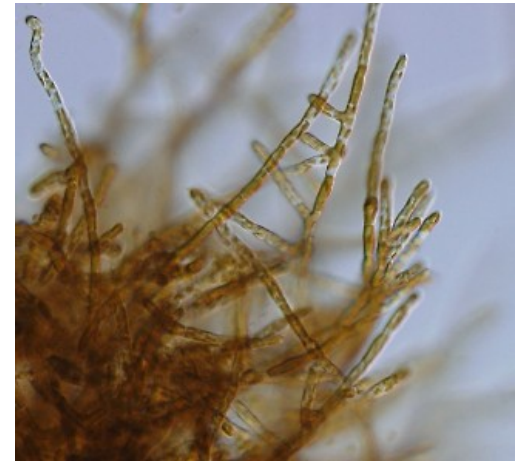
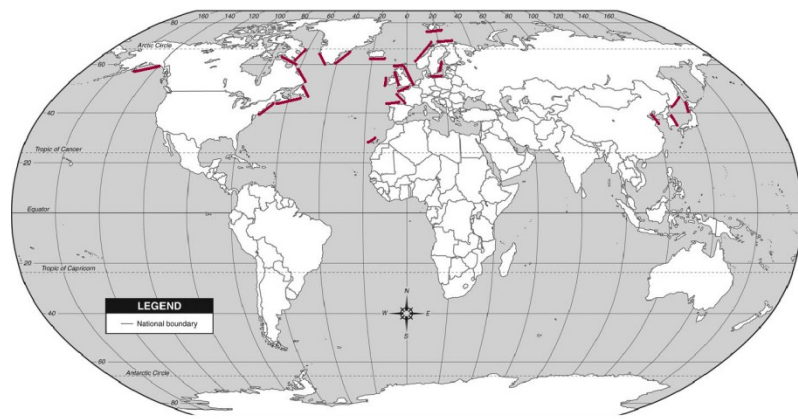


# Chorda

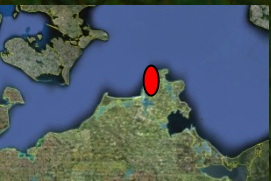
vegetative sporophyte (seasonal),  
hollow tubes (filled by air),  
unicellular paraphyses



<http://www.marlin.ac.uk>

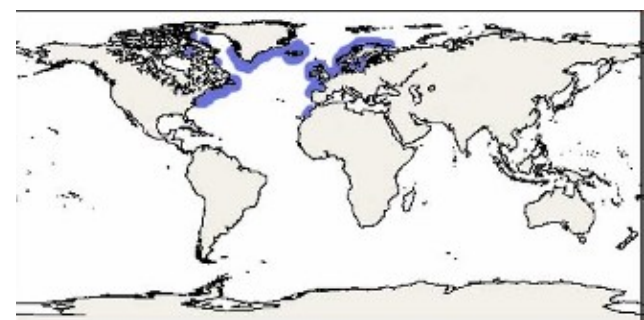
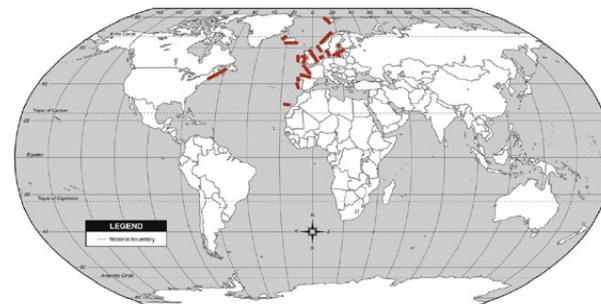
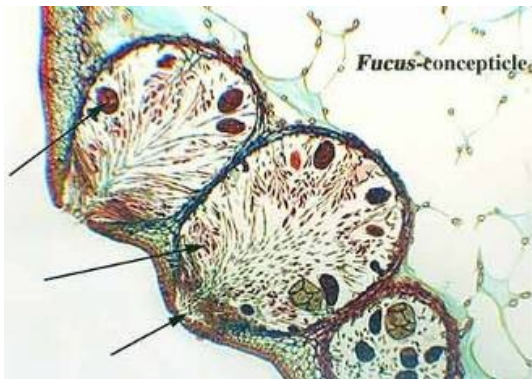


Ch. filum



# Fucales

## Fucus



diplontic life cycle;  
receptacles, conceptacles

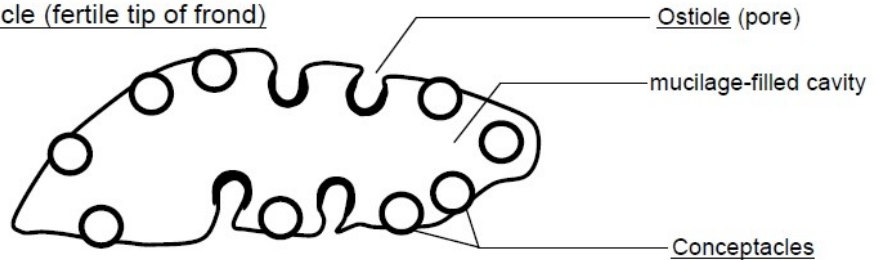
*F. serratus*

*F. vesiculosus*

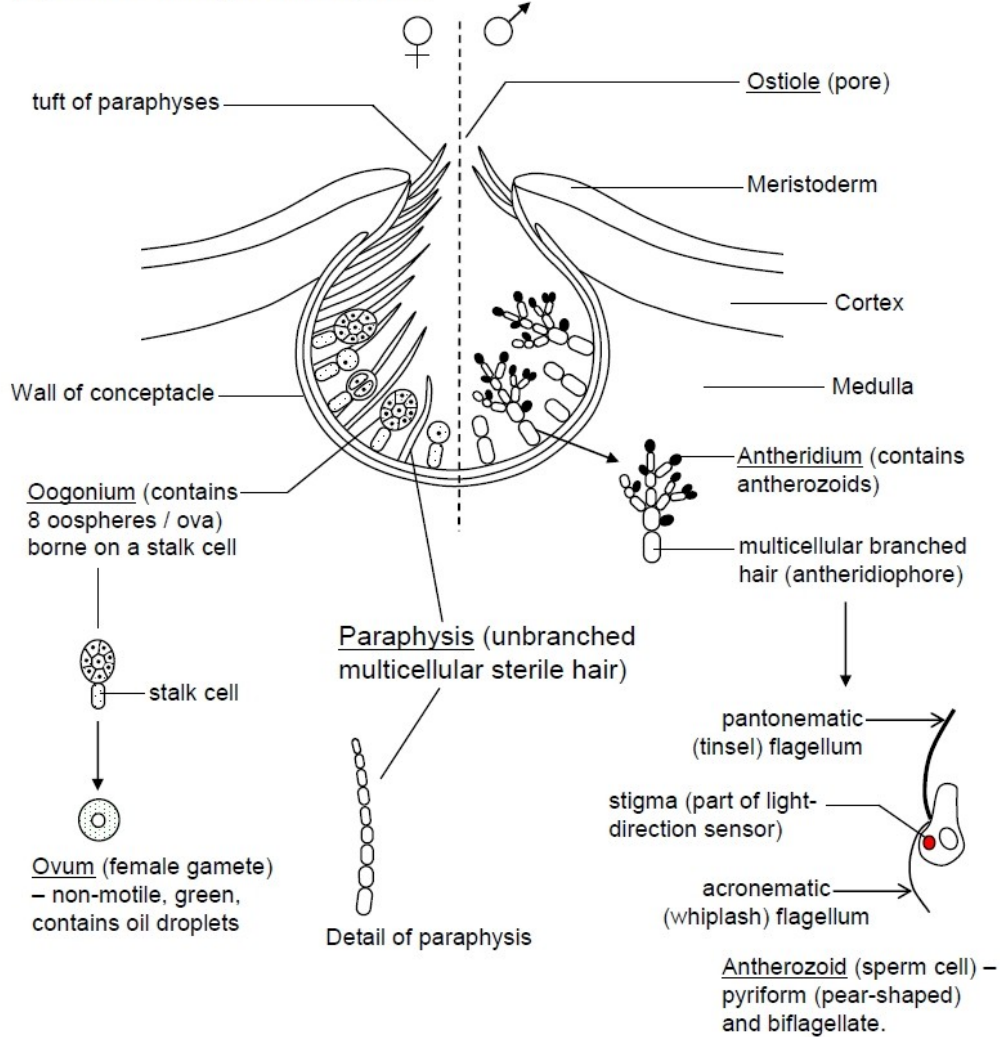
# Fucales

## details of sexual reproduction

(a) Cross-section through receptacle (fertile tip of frond)



(b) Section through a conceptacle



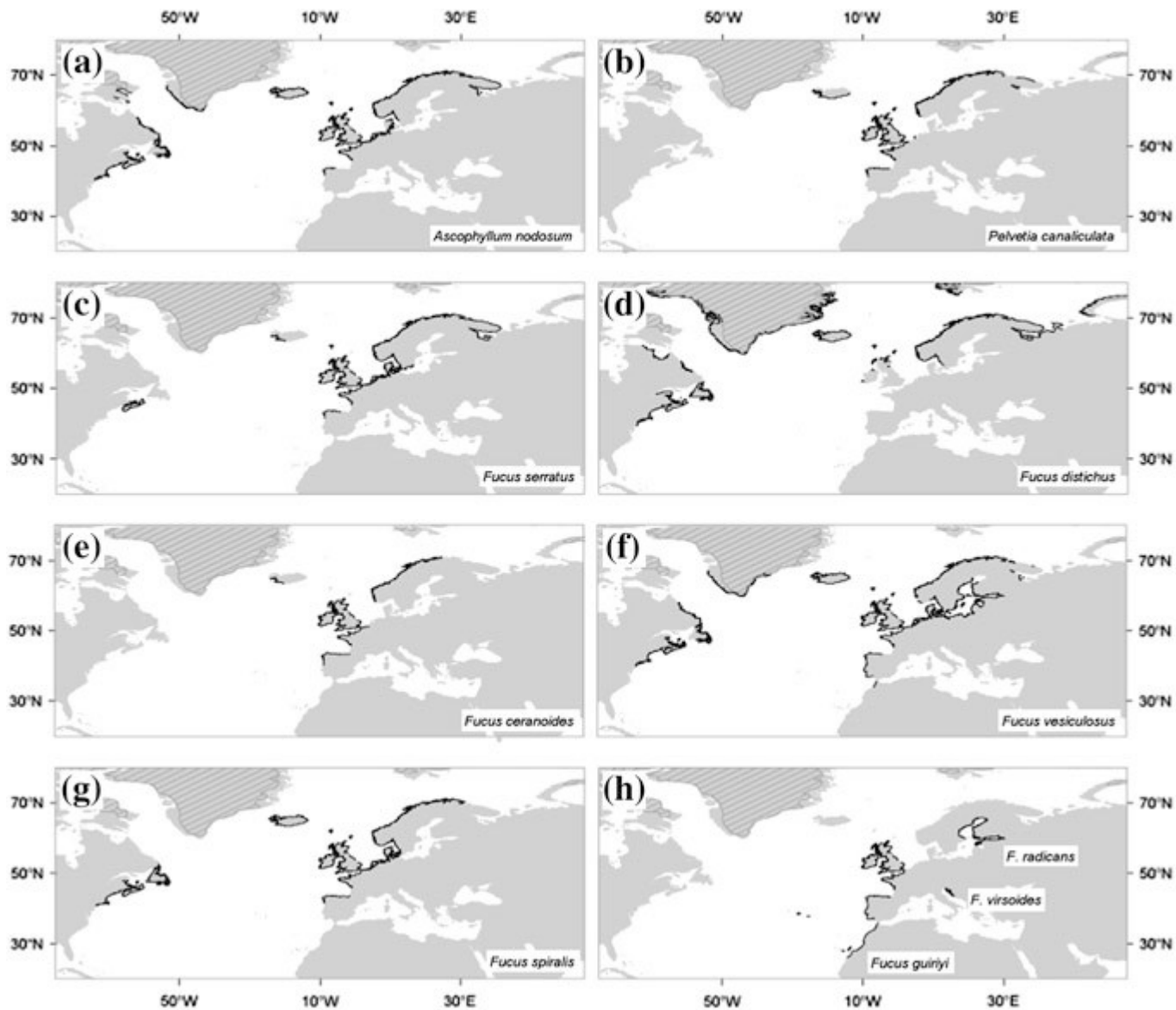
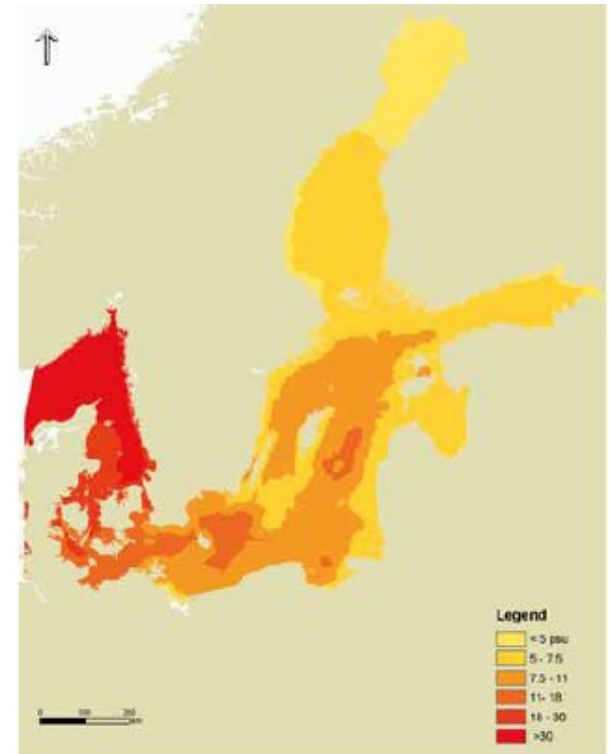
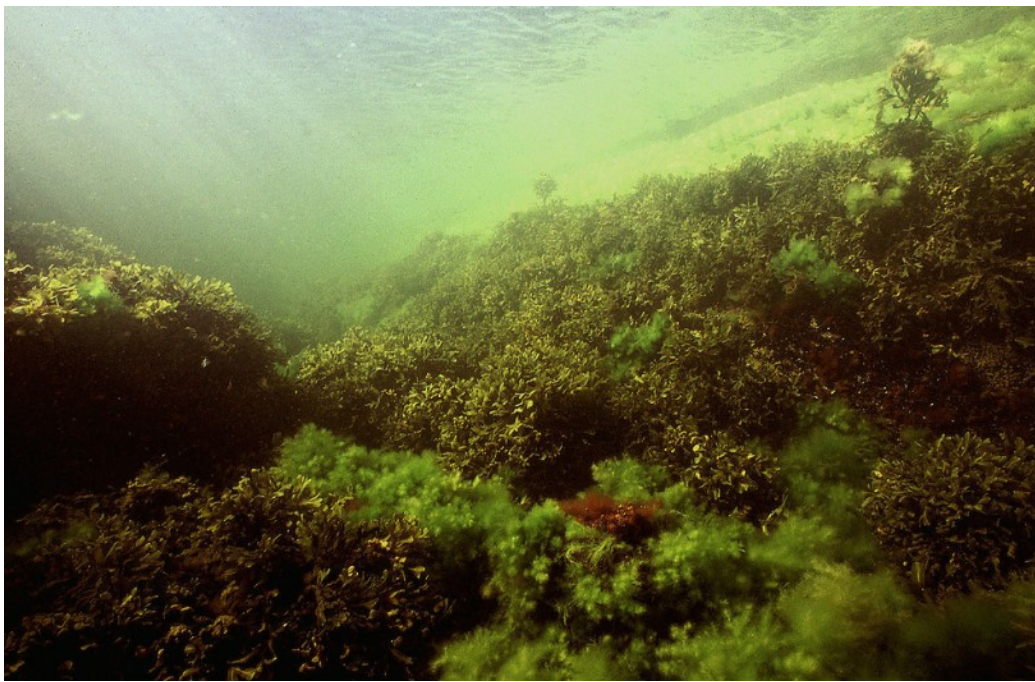


Fig. 11.2 Distribution of Fucaceae species in the North Atlantic. *Dashed areas* depict permanent ice. The distributions of *Fucus distichus* (native all around the Arctic) and *F. spiralis* also include the North Pacific, although the latter appear to have been recently introduced there

Three *Fucus* species are key organisms of the Baltic ecosystems



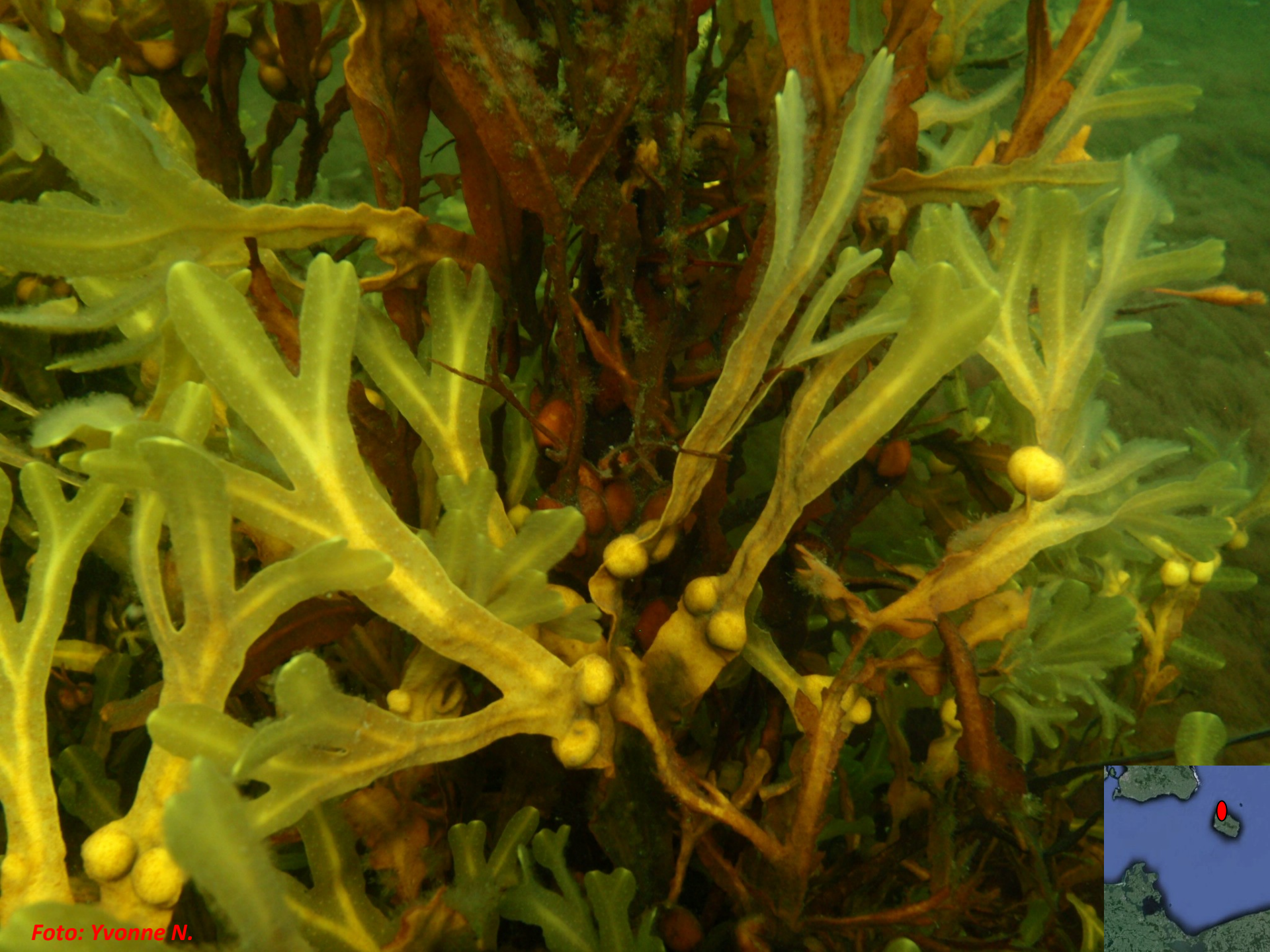
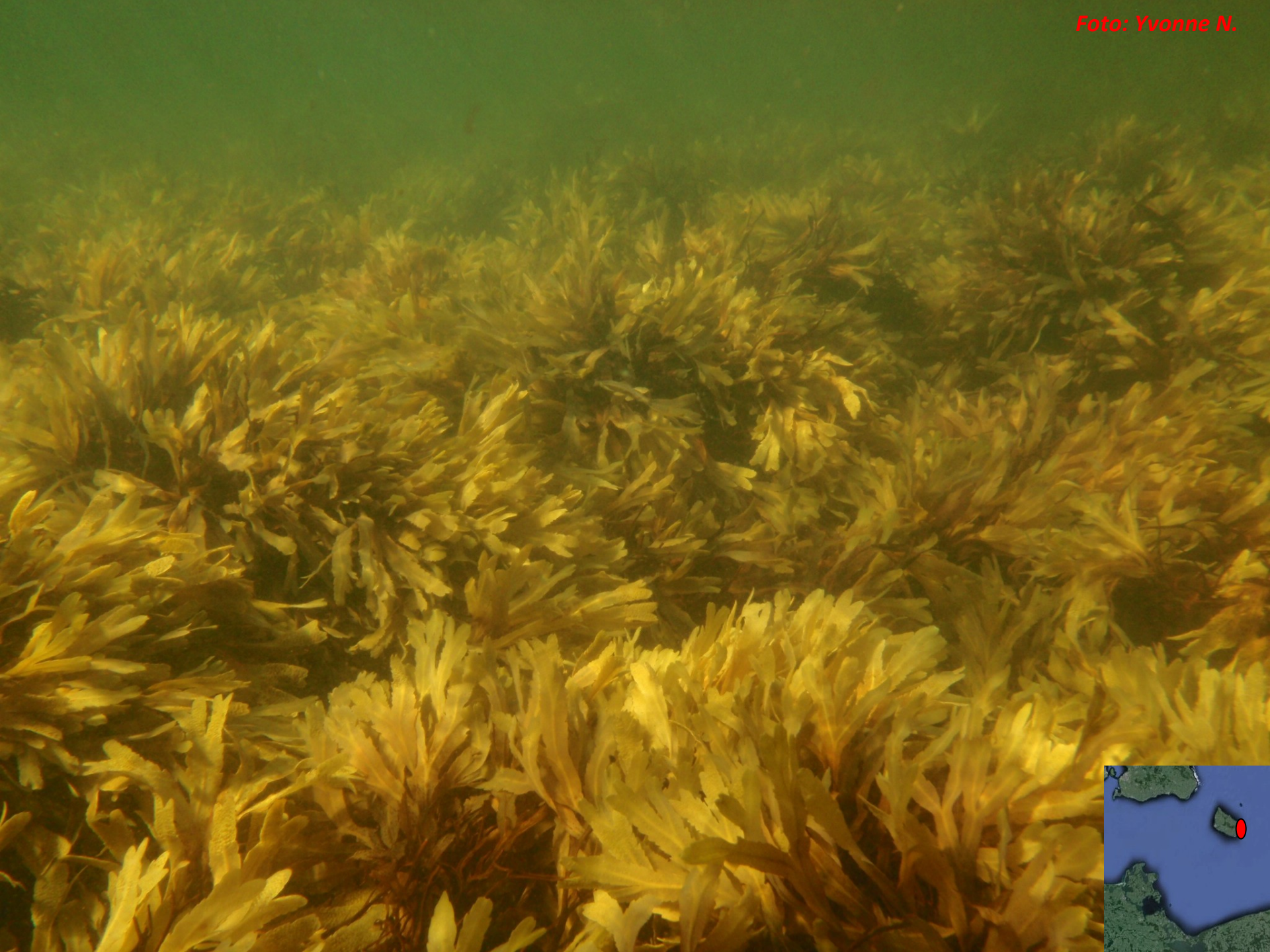


Foto: Yvonne N.





Foto: Yvonne N.



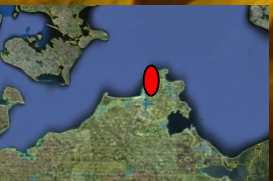
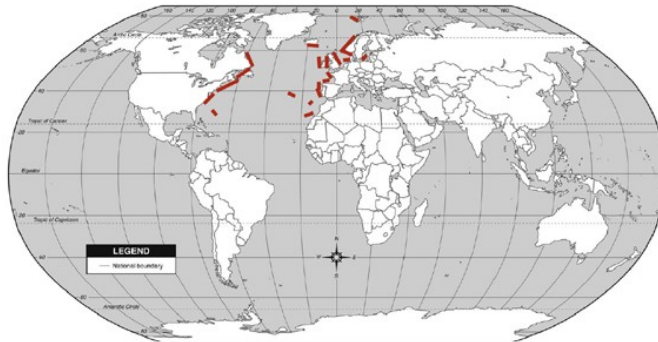


Foto: Yvonne N.

# Ascophyllum



one of the dominant algae of the eulittoral/upper sublittoral of W European coasts (e.g. W Ireland)



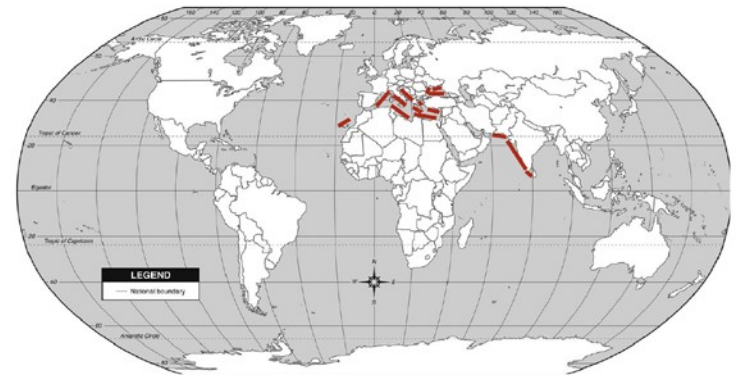
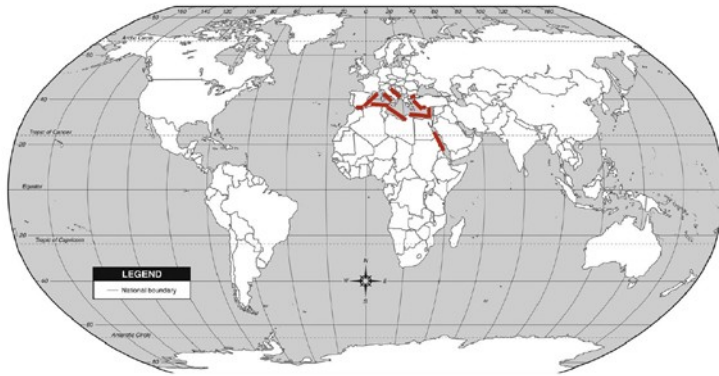
*A. nodosum*

# Cystoseira

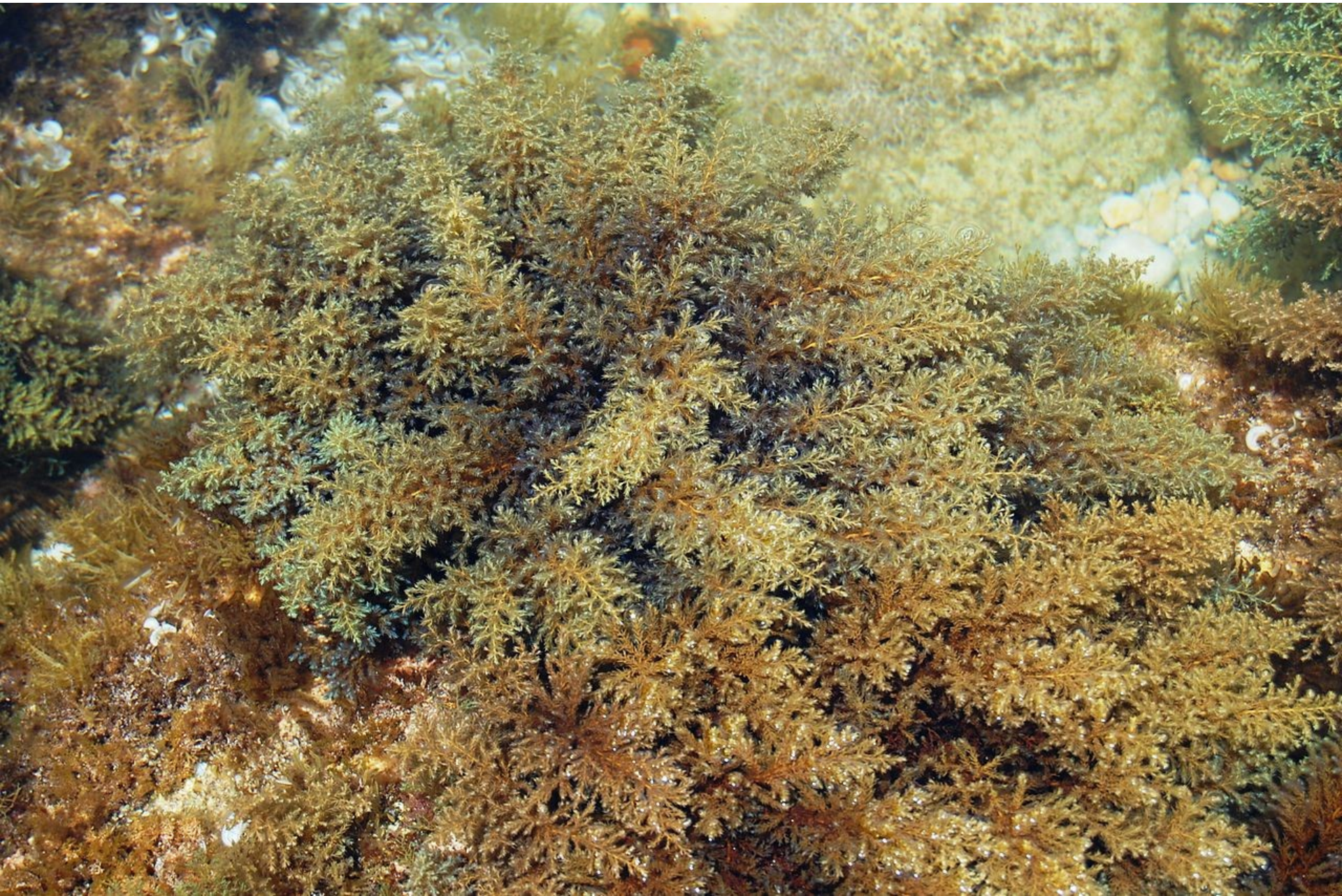


*C. amentacea*

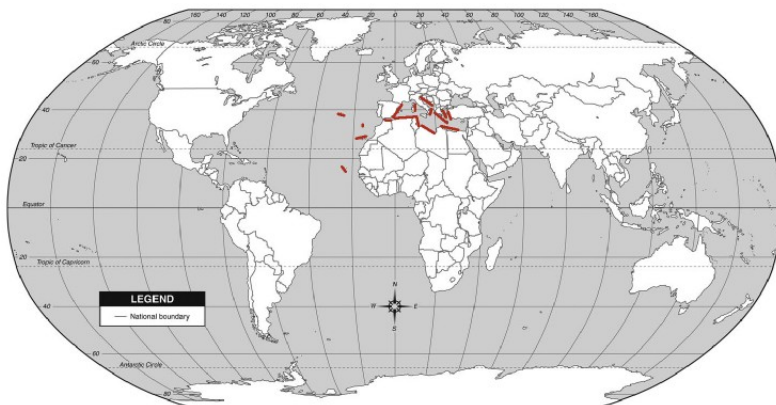
*C. barbata*



species-rich and abundant genus in the Mediterranean





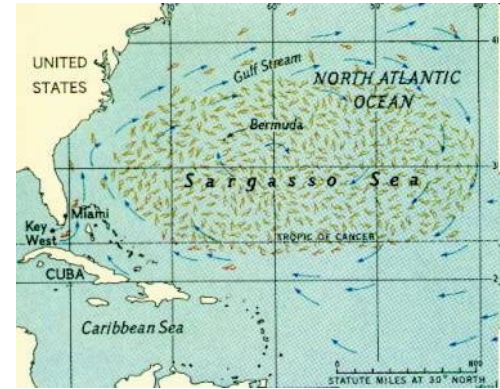
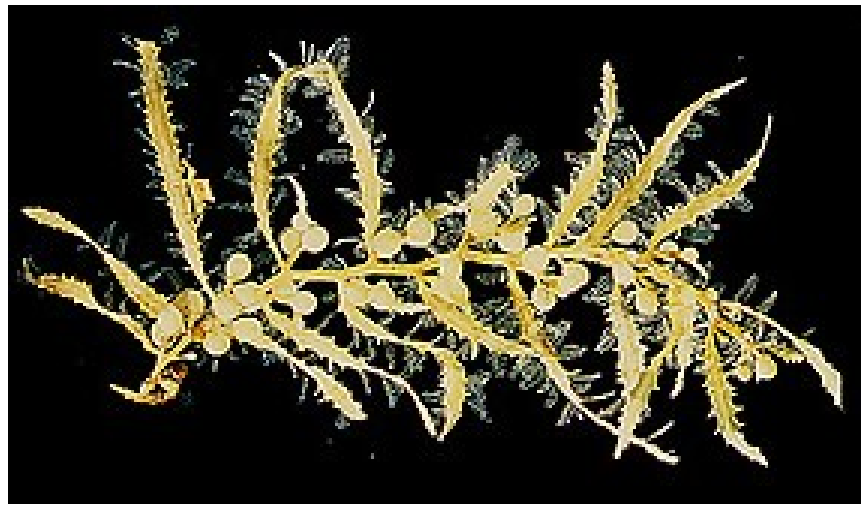


*C. compressa*

[www.algaebase.org](http://www.algaebase.org), [www.azalas.de](http://www.azalas.de)

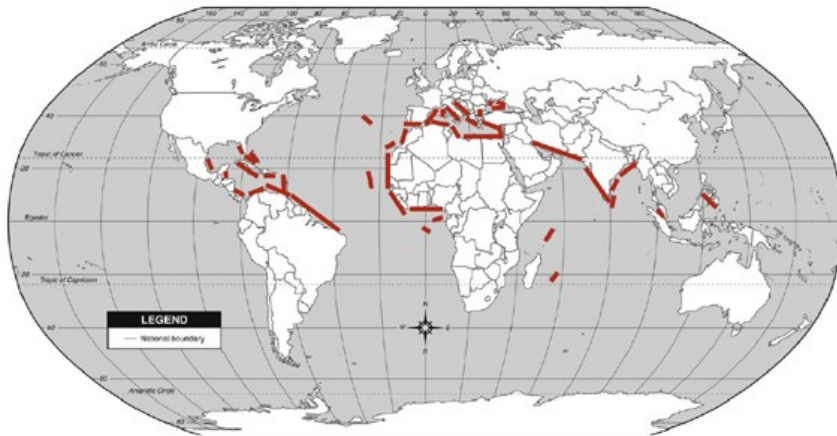


# Sargassum



most taxa in the tropics;  
a few subtropical /warm temperate species;  
benthic and pelagic species

*S. natans*, *S. fluitans*



*S. vulgare*



*S. muticum* – an  
invasive species  
along W European  
coasts

# some examples of biotechnological and food-processing utilization of Phaeophyceae

kombu – *Laminaria*  
wakame – *Undaria*  
hiziki - *Hizikia*

## alginates

